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NUCLEAR SCIENCE ABSTRACTS

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NOTICE

A title page for Volume 19, Numbers 13–18, is included at the back of this issue for use in binding the third quarter of this volume.

CORRECTIONS

NSA Vol. 19, No. 6, pg. 1030. Abstract 8732, in lines 2 and 3 of the citation ... Translation of Patol. Polska, ... Should read: ... Translations from Polish Medical Journals.

NSA Vol. 19, No. 8, pg. 1622. Abstract 13284, in line 6 of the citation ... 9: 41-3 (1964) ... Should read: ... 9: No. 8, 41-3(1964).

NSA Vol. 19, No. 8, pg. 1798. Abstract 14770, in line 2 of the citation ... (Oct. 1962) ... Should read: ... (Oct. 1964).

NSA Vol. 19, No. 14, pg. 3292. Abstract 26673, in line 6 of the citation ... Ser. A, 40: ... Should read: ... Ser. A, 60: ...

NSA Vol. 19, No. 14, pg. 3299. Abstract 26736, in lines 4 and 5 of the citation ... From Proceedings of the ANS Topical Meeting ... Should read ... From Proceedings of the ANS–Canadian Nuclear Association Meeting in Canada of the Niagara-Finger Lakes Section, ANS, and Isotopes Committee, CNA, Toronto, February 12, 1965. (CONF-650216-3)

NSA Vol. 19, No. 14, pg. 3375. Abstract 27399, in line 3 of the citation ... Ser. A, 40: ... Should read: ... Ser. A, 60: ...

NSA Vol. 19, No. 15, pg. 3505. Abstract 28292, in line 7 of the citation ... Ser. A, 40: ... Should read: ... Ser. A, 60: ...

NSA Vol. 19, No. 15, pg. 3560. Abstract 28718, in line 5 of the citation ... Ser. A, 40: ... Should read: ... Ser. A, 60: ...

Volume 19, Number 18, September 30, 1965

NUCLEAR SCIENCE ABSTRACTS

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Volume 19, Number 18 September 30, 1965

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

Refer also to abstract 35615.

33714 (BNWL-C-43) BIOLOGY AT PACIFIC NORTHWEST LABORATORY. Special Report. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [Mar. 1965]. Contract AT(45-1)-1830. 40p. Dep. mn; CFSTI, $2.00 cy, $0.50 mn

Major research activities at Battelle-Northwest's Biology Department on metabolism and toxicity studies in large and small animals, metabolism and toxicity of inhaled substances, molecular and cellular level studies, studies with aquatic organisms, ecology, and analytical and pathological services are reviewed. Information on facilities, scientific personnel, and educational and training activities is included. (P.C.H.)

33715 (LA-DC-6506) SYNCHRONIZED MAMMALIAN CELLS. I. AN IMPROVED METHOD OF STUDY BY ELECTRONIC CELL COUNTING. Petersen, D. F.; Anderson, E. C. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 7p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

An improved method for the precise study of synchrony artificially induced in mammalian cell cultures is described. Limitations of previous methods in terms of accuracy, available sample, time span covered, and experimental complexity are avoided by the use of suspension cultures rather than monolayers and use of electronic particle counting rather than microscopic determination of mitotic index. (C.H.)

33716 (NYO-2043-108) THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Annual Report. Moh, Carl C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)). July 1, 1965. Contract AT(30-1)-2043. 112p. Dep.(mn); $4.00(cy), 2(mn) CFSTI

Separate abstracts were prepared on seven sections of this report. (C.H.)

For abstracts of individual sections see: 33717, 33718, 33731, 33786, 33787, 33788, and 35865.

33717 (NYO-2043-108, pp 5-32) BIOCHEMISTRY AND PLANT PHYSIOLOGY. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

Bacterial chromatophores were separated from cells of Rhodospirillum rubrum, injected into rabbits, and immune reactions were followed. The effects of rabbit antiserum on photosynthetic phosphorylation were determined in photosynthetically active chromatophores of R. rubrum. Preliminary results indicate a stimulation of photosynthetic phosphorylation by the rabbit antiserum. Possible reaction mechanisms involved are discussed. Data are included from a series of studies on factors involved in the sensitivity of cacao seed to cold. (C.H.)

33718 (NYO-2043-108, pp 43-9) CYTOGENETICS OF MANIHOT. Moh, C. C.; Valerio, J. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The root of manihot (cassava, yuca) serves as an important source of carbohydrate in the tropics. This genus includes over 100 species, including shrubs, climbing vines, and trees up to 50 ft tall. Most of the cultivated forms belong to the species Manihot esculenta, a tropical lowland shrub. Preliminary results are reported from a cytogenetic study of this species. (C.H.)

33719 (SAN-536-10) APPLICATION OF RADIOCHEMISTRY TECHNIQUES IN FOOD PROCESSING RESEARCH. RADIOISOTOPIC TRACER TECHNIQUES IN EVALUATION AND IMPROVEMENT OF INDUSTRY PRACTICES FOR REMOVAL OF PESTICIDE RESIDUES FROM FOODS. Annual Report No. 4. Mercer, Walter A., ed. (National Canners Association Research Foundation, Washington, D. C.). Nov. 30, 1964. Contract AT(04-3)-536. 48p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

A standard soil was treated with a commercial DDT formulation which had been enriched with random ring-labeled DDT-^{14}C. Autoradiography of samples of the treated soil showed a satisfactory uniformity of distribution of the pesticide. Periodic analyses of soil core samples indicated a slow downward migration of the pesticide. Extraction of the soil with dichloromethane gave a complete recovery of added DDT-^{14}C in treated soil samples. Red cored Chantenay carrots were grown in five-gallon containers filled with DDT-^{14}C treated soil. Autoradiography of thirty-six day old seedlings showed a faint image in the root system. Evidence was obtained for a root-to-foliage and for a foliage-to-root migration of radioactivity. Carrots grown in soil treated with non-radioactive DDT had radioactivity in the root system. Foliage, sprayed with cold DDT, on carrots grown in DDT-^{14}C treated soil contained radioactivity. The major part of the carrot crop was harvested after 124 days of growth. The carrots were washed in a rotating reel washer using cold water sprays (75 lbs/sq in. pressure) to remove dirt. An interesting distribution pattern was found for radioactivity in various parts of the washed carrots. Sixty-eight percent of the radioactivity was found in the rootlets, tap root end, and skin. These portions, which represent less than seven percent of the carrot weight, are removed by food preparation operations. The level of DDT or its transformation products in the prepared carrot was less than 0.05 ppm. An extraction of the foliage cut from the harvested carrots was made to isolate possible transformation products from the DDT. The extract was purified by column chromatography and the eluate fractions analyzed by electron capture gas chromatography and thin layer adsorption chromatography. Autoradiography of a developed thin-layer plate demonstrated the presence of radioactive spots (in addition to the major component DDT-^{14}C) corresponding in R_f to 2,2-dichloro-1,1-bis(p-chlorophenyl)-ethene (DDE-^{14}C) and to 2,2-dichloro-1,1-bis(p-chlorophenyl)-ethane (TDE-^{14}C). The low level of

radioactivity in peeled carrots made further studies on the reduction of pesticide residue content by blanching and preservation by dehydration, freezing, and canning of little practical significance. In a continuing program to improve pesticide residue analytical procedures, a method of separation and identification of chlorinated pesticides was developed. New methods for the clean-up and thin-layer chromatography of thiophosphate pesticides are described. The masking by crop extractives was reduced by using glycerine in the assy jars or by employing a more rigorous cleanup procedure. (auth)

33720 LEUKEMIAS IN POLAND. Janicki, Kazimierz (Medical Academy, Krakow). Acta Med. Polona 3: 267-81 (1964).

In the course of studies on the influence of physical, biological, and social environment on the incidence of leukemic processes, an analysis was carried out on some problems connected with the epidemiology and geography of the leukemias. A significant increase in the incidence of leukemia has been widely observed. This survey is based on the statistical data of the Polish Ministry of Health and Social Welfare. This showed a statistically significant increasing trend in the incidence of leukemias in Poland, based on the numbers of hospitalized patients in the years 1951 to 1959. The increase in the incidence of leukemias held for both sexes, but the incidence in males was higher than in females. Morbidity of leukemias in Poland also showed an increasing trend, especially in the last five years of the period studied. Increased morbidity of leukemias was found in the urban and rural populations alike; morbidity in urban populations was higher than in the rural populations throughout the period studied. Differences in the morbidity of the leukemias were found between different provinces and cities. Mortality from leukemias in Poland in the years 1951 to 1959 also showed a continuous, significant increase, whereas overall mortality from all causes showed a decline at the same time. It is suggested that the observed geographic differentiation in the morbidity of leukemia may be the result of fortuitous factors, such as diagnostic facilities and reliability of the statistical data, or, more likely an expression of leukemogenic environmental factors, e.g., those connected with industry, climate, and ionizing radiation. On the basis of the results of an analysis of the morbidity of leukemias in the Krakow region, it was concluded that specific ecologic factors played a significant role in this differentiation. (BBB)

33721 INDIRECT IMMUNOURANIUM TECHNIQUE FOR STAINING OF EMBEDDED ANTIGEN IN ELECTRON MICROSCOPY. Sternberger, Ludwig A.; Donati, Edward J.; Cuculis, John J.; Petrali, John P. (Edgewood Arsenal, Md.). Exptl. Mol. Pathol., 4: 112-25(Feb. 1965).

Uranium, as uranyl ion, was coupled with antibody which was then combined with antigen, making an electron-dense site observable by electron microscopy. Sheep antibody to rabbit antibody was immunospecifically protected during extensive chelation with U in a procedure which involved insolubilization of rabbit γ-globulin (RGG) by coupling with diazotized p-aminobenzylcellulose, specific absorption of antibody, exposure of antibody-RGG-p-azobenzylcellulose to uranyl acetate solution, and elution of antibody by alkali. The antibody was 40 to 75% pure and contained 29 to 90 atoms of U per molecule. Antigen first localized by specific rabbit antiserum became electron dense upon treatment with immunospecifically purified and protected, U-conjugated sheep antibody to rabbit antibody. Staining after sectioning for electron microscopy was facilitated by pretreating sections with benzene-saturated water. Alkali treatment of unprotected, U-chelated areas in antibody and γ-globulin appeared to effect irreversible structural changes leading to increase in size and solvation of the molecule. Protected sites did not seem to participate in these changes appreciably. The observed sedimentation velocity of U antibody was similar to that of antibody or RGG devoid of U. Also, the partial specific volume of U-conjugated, alkali-treated, γ-globulin was found to be increased, as expected. On electron microscopic observation, U antibody was found equally long, but more than twice as wide as unlabeled antibody, indicating a more than fourfold increase in size. These extensive changes in structure of U-antibody and γ-globulin do not, however, involve the effective specific sites of antibody, which have been protected during chelation and are therefore devoid of U. (BBB)

33722 STAINING OF VACCINIA ANTIGEN BY IMMUNOURANIUM TECHNIQUE. Donati, Edward J.; Figge, Frank H. J.; Sternberger, Ludwig A. (Edgewood Arsenal, Md.). Exptl. Mol. Pathol., 4: 126-9(Feb. 1965).

In using the immunouranium technique (cf. preceding abstract) for the electron microscopic localization of embedded protein antigen, fixation, and embedding may seriously impair antigenic reactivity. In the present study, a compromise was reached between optimal fixation which would yield good resolution but destroy antigenicity, and minimal fixation which gives poor resolution but may maintain some antigenic reactivity. With these limitations, it was possible to follow morphologically the development of vaccinia antigen in HeLa cells. With specific U staining, viral particles were first seen 14 hr after infection. They had increased in number by 20 hr. Viral particles were characterized by U staining of their walls and absence, in most cases of staining of their cores. Two types of localization were observed. In one type, the particles appeared in small clusters scattered in the cytoplasm; in the remaining sections the cytoplasm contained large specifically staining masses consisting of closely packed viral particles as well as amorphous stained material. In control sections viral particles were detected only with difficulty. Most cells which possessed scattered clusters of viral particles, but not those which had inclusion bodies, also showed U staining in areas beyond the confines of viral particles that was not seen in control sections, the significance of which is not yet clear. (BBB)

33723 PRESERVATION OF BONE MARROW AND BLOOD AT CRYOGENIC TEMPERATURES. Richards, V.; Persidsky, M.; Braverman, M.; Lowenstein, J.; Floridia, R.; Rosolia, H. (Presbyterian Medical Center, San Francisco). J. Cardiovasc. Surg., 5: 313-26(July-Aug. 1964).

Presently available methods are reviewed and improved methods were sought for preservation of bone marrow and blood cells at low temperature, these products becoming increasingly in demand for use in lethally irradiated subjects and with organ transplantation. A simplified cooling chamber was developed permitting slow freezing at a rate of 1°C/min down to −27°C, with the opportunity of observing the specimen during the freezing process and initiating ice formation at various levels of supercooling. Cell survival was quantitated by correlation of three observations: (1) microscopic counting of live vs dead cells under the phase microscope after thawing and tissue culturing of the thawed cells, (2) the incorporation of ^{14}C-glycine into the preserved thawed cells, and (3) the injection of preserved thawed cells into isogenic lethally irradiated mice. The microscopic, chemical, and biologic methods of assessing cell survival correlated closely. It was also shown that polyvinylpyrrolidone (PVP) of molecular weight about 40,000 in 10% concentration is superior to other preservatives for freezing bone marrow. Slow freezing at a rate of 1°C/min down to −27°C was preferable to rapid freezing, and ice formation could be initiated at −5° to −10°C. Studies with radioactively labeled PVP were made to demonstrate whether the PVP remained entirely extracellular, as would be expected from its molecular weight, or what proportion of it entered the cell, possibly by pinocytosis. Over 95% of the PVP remained extracellular in location. PVP yielded a higher percentage of cell survival after slow freezing than did glycerol, but it was not superior to dimethylsulfoxide (DMSO). However, after thawing, these studies indicated some toxicity from DMSO, with a slow progressive decline in survival of thawed cells, so that PVP seemed preferable to either glycerol or DMSO. Attempts to induce intracellular penetration of PVP by phosphate enhancement of pinocytosis did not improve cell survival. Under optimal conditions employing 10% PVP, about 30% of marrow cells were found to survive. Possible ways in which PVP may protect bone marrow cells from injury during freezing and

thawing are discussed. Successful results are described in four patients with cancer in whom PVP-preserved and stored autologous marrow was reinfused following massive doses of nitrogen mustard. These patients all suffered from extensive lymphoblastomas with widespread metastases. Marrow was collected aseptically in the operating room from the sternum, iliac crest, and tibia, and PVP was added so that the final PVP concentration was 10%. The PVP marrow was slowly cooled to −27°C at a rate of 1°C/min, and then the marrow was stored at −179°C. A ^{51}Cr double-labeling technique is described which was used to follow the survival of the injected cells in the patient's circulatory system. (BBB)

33724 ABNORMAL TRACE METALS IN MAN: NIOBIUM. Schroeder, Henry A.; Balassa, Joseph J. (Dartmouth Medical School, Hanover, N. H.). J. Chronic Diseases, 18: 229-41(Mar. 1965).

Environmental exposures of man and animals to Nb were surveyed by analyses of soils, vegetation, foods, and water; organ concentrations of animals were ascertained; and a pilot study of human biomaterial was initiated. Niobium is ubiquitous in the biosphere. The daily intake of man is 600 μg or more, found in water and nearly all animal and vegetable foods analyzed. About half of the amount ingested is absorbed and excreted via the urine. It is carried in blood mainly in erythrocytes. The tissues of man and wild, domestic, and lab animals contain Nb in sizeable amounts comparable to those of Cu and exceeded only by those of Fe, Zn, and Rb, among trace elements. Niobium was found in vegetation, wood, soils, and superphosphate fertilizers and was somewhat concentrated in fats and oils. Heavy fertilization appeared to suppress uptake of Nb by growing vegetables. What is known about Nb is consistent with its having some physiological function, but definitive data are lacking. As evidence for its essentiality, however, Nb fulfills several criteria: (a) it is ubiquitous in soil, sea water, plants, and animals (and was undoubtedly ubiquitous when life began); (b) its chemical nature is not incompatible with some physiological action; (c) its atomic number falls within those metals essential for living things, 1 to 42, and which comprise the most abundant elements in the universe and on the earth; (d) Nb is present in milk and in the tissues of the newborn rat, presumably passing mammary and placental barriers. On the other hand, it is uncertain as to whether or not it accumulated in human tissues with age, which no essential trace metal does significantly except in certain diseases. Its only known specific biological activity, in vitro or in vivo, is the oxidation of 5-hydroxytryptophan. (BBB)

33725 THE EFFECTS OF STRONTIUM AND OTHER DIVALENT CATIONS ON POTASSIUM CONTRACTURE IN A LOCUST LEG MUSCLE. Aidley, D. J. (Oxford Univ.). J. Physiol. (London), 177: 103-11(Mar. 1965).

It was previously established that Ca ions are necessary for the production of K-induced contractures in the mesothoracid extensor tibialis muscle of the locust Schistocerca gregaria, and present experiments investigated whether other divalent cations would substitute for Ca in this reaction. Ringer's solutions containing these abnormal cations were made by substitution of the cation for Ca, and contractures were produced by perfusion of the muscle with a solution containing 164-mM KCl and 100-mM D-glucose. Addition of salts of Sr, Co, and Ni to Ca-depleted muscle in KCl solution caused a brief submaximal contraction. Salts of Mg, Ba, and Mn did not produce contraction under these conditions. After perfusion of a Ca-depleted muscle with a Ca-free Ringer's solution containing 4 mM $SrCl_2$, perfusion with KCl solution causes a phasic contracture which may reach 25% of the maximum tension produced under normal conditions of Ca ion concentration. Successive responses to depolarization in the presence of Sr ions decline in the absence of Ca ions. It is concluded that Ca is probably uniquely important in excitation-contraction coupling in this muscle, and that Sr and other substitute cations act by displacing Ca from some site at which it is bound in the muscle. The comparative physiology of Sr ion action in excitation-contraction coupling is discussed. In the frog heart, Sr and Ba salts are similar to Ca salts in their effects on contractility, and ^{85}Sr can be used as a tracer for Ca. There is some competition between Ca and Sr ions, and higher tensions are produced in a Ca-free Ringer containing Sr ions than in normal Ringer solution. At low Ca^{2+} concentrations, the presence of Sr ions causes an increase in the contraction of cat papillary muscle which was associated with a lengthening of the R-T interval of the electrocardiogram. Strontium and Ba ions can substitute for Ca to some extent in the uterine muscle of the rat, but the muscle appears to distinguish Ca from Sr in that after a brief exposure to Ca ions the ability to produce contracture persists for some time, whereas this does not occur after a similar exposure to Sr ions. There are many differences between the actions of Sr and Ca ions on vertebrate muscles, but these differences are fewer than are seen in locust muscle, where Sr is far from being an adequate substitute for Ca. (BBB)

33726 ATOMIC ENERGY FOR AGRICULTURE. Mia, M. M. Nucleus (Lahore), 2: No. 1, 30-4(Jan.-Mar. 1965).

The importance of using in agricultural fields the latest research tools — radioisotopes and radiation sources — in Pakistan is discussed. A brief survey is presented of the activities of the Agricultural Research Centre, Dacca in plant genetics, plant physiology, soil chemistry, and entomology. The IAEA-PAEC coordinated program is also briefly discussed. (L.B.S.)

33727 DNA SYNTHESIS DURING GERMINATION OF BACILLUS SUBTILIS SPORES. Yoshikawa, Hiroshi (Univ. of California, Berkeley). Proc. Natl. Acad. Sci. U. S., 53: 1476-83(June 1965).

The effect of chloramphenicol on DNA synthesis during germination of B. subtilis spores was studied. Analysis of DNA synthesized after the addition of chloramphenicol at various times showed that a protein is synthesized before each cycle of generation in order to initiate chromosome replication. Repair-type synthesis was found in spores germinating in the presence of chloramphenicol and under these conditions there was no indication of normal replication. The presence of DNA polymerase activity was demonstrated in the spore. The nature of this DNA polymerase was discussed in relation to the initiation mechanism of chromosome replication. (auth)

33728 EXPERIMENTAL RESEARCH ON HETEROLOGOUS BONE MARROW GRAFTS. I. EFFECT OF DELTACORTENOL. D'Angelo, A.; Chiovato, I. (Universita, Messina, Italy). Riv. Patol. Clin., 17: 812-26(Oct. 1962. (In Italian)

In view of the usefulness of transplanted bone marrow in lethally irradiated animals, means were sought to stimulate the proliferation of bone marrow grafts in recipient animals. Ways for distinguishing the recipient's own cells from the donor cells among the leukocytes in peripheral blood were examined. Mechanisms of the secondary syndrome in radiation chimeras wherein proliferating donor cells interact immunologically with the recipients tissues are discussed. Because of the favorable action of corticosteroids in depressing immune reactions, experiments were conducted with a derivative of hydrocortisone, Deltacortenol. Fifty adult albino mice were divided into three groups. The first group was treated with 2 mg/day of the steroid for six days. A second group was injected intraperitoneally with heterologous (rat) bone marrow. The third group received both steroid and bone marrow injections. Blood cell counts were followed in all three groups. In the first group, steroid treatment progressively lowered the leukocyte and erythrocyte counts. Injection of rat marrow cells in the second group caused a sharp, transient increase in leukocytes without affecting red cell counts. In the third group, marrow injection in steroid-treated mice halted the decline in red cell counts and stabilized the level slightly below normal. The leukocyte counts in this group rose sharply and reached a max 10 to 20 days later, which was followed by a slow decline. All of these animals showed loss of appetite, deterioration of general condition, and death in a state of cachexia about 60 days after injection of bone marrow. The presence of

rat leukocytes in mouse blood could be detected, by their cytochemical alkaline phosphatase activity, up to 50 days after injection. (BBB)

33729 THE URANYL ACETATE REACTION AS LIVER FUNCTION TEST. Khayat, M. H.; Aas, D.; Schluetz, G. O. (Univ. of Damascus, Syria). Z. Klin. Chem., 3: 60-1(Apr. 1965).

A simple, rapid, and inexpensive liver function test is described which is based on the uranyl acetate reaction. The use of the test in 61 patients known to have primary liver disease is reported, the results indicating that the test is reliable and gives close correlation with the Hanger and McLagan tests. The test is performed by adding 0.1 ml of serum to 6 ml of uranyl acetate solution (prepared by dissolving 40 mg of the salt in 100 ml of water and diluting this stock solution 1:5 with water). A positive test is seen as opalescence of the solution associated with flocculation. In frankly positive sera, sedimentation of the floccula is noted after leaving the solution for one hour at room temperature. The results are more conveniently read by adding cochineal tincture (2 drops) to the system which gives the supernatant uranyl acetate solution a green color. In some of the 61 cases who were found to have some degree of liver disease the uranyl acetate reaction was often positive when the thymol turbidity and cephalin-cholesterol flocculation tests were still negative. Sera from patients with infectious hepatitis are positive early in the disease, however, the reaction becomes negative as the jaundice begins to clear up. Sera from patients with hepatic cirrhosis consistently gave a positive uranyl acetate reaction. The degree of flocculation corresponded to the severity of the disease. Patients with obstructive jaundice give a negative reaction. Paper electrophoresis was conducted on the positive sera. Although hypoalbuminemia and hypergammaglobulinemia were noted in many of the cases, no constant correlation could be found between these modifications in the serum proteins and the positivity of the test. It is suggested that a new component may appear in the serum which flocculates with the uranyl acetate. (BBB)

33730 CELL DIFFERENTIATION AND SOMATIC MUTATION. Report of Symposium held on August 8 to 9, 1963. Gamma Field Symposia Number 2. Ohmiya, Japan, The Institute of Radiation Breeding, Ministry of Agriculture and Forestry, 1963. 95p. (CONF-630804)

A separate abstract was prepared for one paper. Three papers were abstracted previously and appeared in NSA Vol. 19 as numbers 12996, 21911, and 21912. (C.H.)

For an abstract of the individual paper see: 33955.

Ecology

Refer also to abstract 34365.

33731 (NYO-2043-108, pp 95-7) STUDIES ON THE BIOLOGY OF THE TROPICAL OX WARBLE FLY, DERMATOBIA HOMINIS LINN. Katiyar, K. P.; Ferrer, F.; Moya, G. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The parasitic larvae of the tropical warble fly, or torsalo, causes cutaneous myiasis in cattle and is a serious insect pest in Central and South America. Preliminary data are presented from a study on the biology of Dermatobia hominis. (C.H.)

33732 (ORNL-P-262) EFFECTS OF POPULATION DENSITY ON GROWTH RATES OF ANIMAL POPULATIONS. Tanner, James T. (Oak Ridge National Lab., Tenn.). July 29, 1964. Contract W-7405-eng-26. 52p. Dep.(mn); $3.00(cy), 1(mn) CFSTI.

The growth rate of a population is defined as the change in numbers per unit population at the time of the change per time ($r_t = dN/N_t dt$). The objective of this study was to determine whether the growth rate is or is not a function of the population density. In most mathematical models of populations whose changes resemble those of actual populations, the growth rate is a decreasing function of population density. The relation between the growth rate and population density of actual animal populations was determined from the records of 111 different populations representing 71 species. Growth rates were calculated for each interval of time; regression methods were then used to calculate a coefficient of growth rate on population density and to test whether or not this coefficient was significantly different from zero. Of the 71 species represented, 7 were eliminated from further analysis because their census records were not significantly different from a series of random numbers, 42 had negative coefficients significantly different from zero, 21 had coefficients not significantly different from zero (all but one of these estimated coefficients were negative), and one, the world's human population, had a positive coefficient significantly different from zero. There were no differences between taxonomic groups (insects, other invertebrates, fish, birds mammals). The primary conclusion is that in most animal species a population's growth rate is a decreasing function of density. This explains the relative stability of animal populations, which rarely continue to increase at rates their fertility would allow and rarely decrease to extinction. Tentative conclusions are presented regarding the processes regulating population numbers. Populations of herbivorous insects at low and moderate levels are regulated by predators and parasites causing mortality that is an increasing function of density. Favorable conditions may allow an increase in insect numbers so rapid that the population temporarily escapes regulation by its enemies. Nonterritorial species of vertebrates are normally controlled by predation and, when that fails, by competition; in both cases juvenile individuals are most affected. In territorial vertebrates competition for suitable territories determines the size of the breeding population. Populations of vertebrate species (excepting man) are in general regulated by the production of adult individuals being a decreasing function of population density. (auth)

33733 (TID-21791) A STUDY OF THE MOVEMENTS OF THE CHANNEL CATFISH, ICTALURUS LACUSTRIS PUNCTATUS, IN THE SAVANNAH RIVER AND ONE OF ITS TRIBUTARIES WITHIN THE AEC SAVANNAH RIVER OPERATIONS AREA. Humphries, Robert L. (Georgia Univ., Athens. Inst. of Radiation Ecology). 1965. Contract AT(07-2)-10. 62p. Dep. mn; $3.00 cy, $0.75 mn. CFSTI.

Results are reported from a study of the movement of the channel catfish (Ictalurus lacustris punctatus) in the Savannah River at the plant of the U. S. Atomic Energy Commission in Aiken, Barnwell, and Allendale Counties, South Carolina. The aim of the study was to determine the extent and nature of the movement of channel catfish in the river and one of its tributary streams. (C.H.)

33734 A REPORT ON THE LABELING OF SCHISTOSOMA JAPONICUM CERCARIAE WITH RADIOIRON. De La Cruz, B. (Philippine Atomic Energy Commission, Manila); Pesigan, T. P.; Banzon, T. C.; Sevilla, J.; Donato, C.; Cruz, A.; Castro, V. Am. J. Trop. Med. Hyg., 13: 545-7 (July 1964).

Attempts were made to label the liver fluke so that its mode of distribution in the body could be followed. It would be informative to trace the cercariae until they become adult flukes in the different organs of the body either in their natural habitat in the portal circulation or elsewhere. Iron-59 in the form of ferric chloride solution, adjusted to pH 6 by the addition of sodium citrate, was used. The cercariae were exposed to different strengths of radioiron before inoculation: 0.1, 0.9, or 2.4 μC. These cercariae were inoculated on the shaved abdomen of adult mice. After 30 days, all the mice were sacrificed, and the flukes were recovered by perfusion. The recovered flukes were washed twice with tap water, mounted on slides, and autoradiograms were taken. From these autoradiograms, it was evident that definite images of the flukes recovered from the experimental mice were demonstrable. On the other hand, no image could be seen in the autoradiogram of the flukes from the control mouse. Thus ^{59}Fe was taken up by the cercariae, bound to some of their component parts, and retained throughout the course of their development into adult flukes. Precautions were taken against any radioactive contamination of the flukes during perfusion and preparation of the autoradiograms. The results

indicate that the cercariae of S. japonicum can be labeled with ^{59}Fe. Although no attempt was made to determine radioactivity just after exposure of the cercariae, because of the lack of a suitable method, this conclusion is based on the fact that the adult flukes developing from the cercariae gave positive autoradiograms. This is indirect proof that the cercariae can be labeled with ^{59}Fe. In a previous report describing a similar method of labeling the cercariae of Schistosoma mansoni by incubation in ^{59}Fe it was not possible to detect any radioactivity in the adult flukes that developed from them and it was concluded that the ^{59}Fe tag did not remain with the growing S. mansoni fluke. In the present experiment, tests for radioactivity in the flukes first performed with a 2 × 2 in. NaI crystal connected to a single channel analyzer showed only background activity. After having failed with that procedure, however, the radioactivity of the flukes was eventually demonstrated by means of contact autoradiography, the method that is considered most useful for this purpose. (BBB)

33735 EFFECTS OF CHRONIC GAMMA IRRADIATION ON THE DEVELOPMENT OF OLD FIELD PLANT COMMUNITIES. Woodwell, G. M.; Oosting, J. K. (Brookhaven National Lab., Upton, N. Y.). Radiation Botany, 5: 205-22(July 1965). (BNL-8398)

First- and second-year old field plant communities were allowed to develop in sections of the Gamma Radiation Field at Brookhaven National Laboratory. The communities developing under irradiation differed in general from non-irradiated communities in lower diversity of species, in lower total plant cover, and in the densities of individual species. Changes in species composition of the communities along the radiation gradient were proportional to the daily radiation exposure, a 50 per cent reduction in the coefficient of community corresponding to an approximately 3-fold change in radiation exposure rate. While there was an overall decline in total density along the gradient of increasing radiation, densities of individual species varied greatly without simple relationship to radiation exposure. Individual plants in the irradiated communities differed in form and in reproductive potential from those in non-irradiated communities. At exposures in excess of 320 r/day growth of most species was inhibited and anomalies in form were common. The reproductive potential of Erigeron canadensis, one of the relatively resistant species of the second year communities, was zero at exposures of 320 r/day and above, although individual plants survived 640 r/day. Results show that any threshold for effects of radiation on species composition of old field communities lies at less than 50 r/day; changes in species composition are approximately linearly related to the logarithm of daily radiation exposure; the principle of species individuality appears to apply to communities exposed to ionizing radiation as it does to communities along other environmental gradients; the individuality of species' responses to radiation results in a different community at each radiation exposure; all the higher plants of the old field communities in this study are relatively radioresistant; resistance is correlated in these field studies with low average interphase chromosome volumes and with relatively high degrees of polyploidy; using the effects of irradiation on the reproductive capacity of Erigeron as an example, sexual reproduction remains substantially intact at exposures as high as $\frac{1}{6}$ to $\frac{1}{3}$ those required to exclude the species from the community; reduced quantities of viable seeds are produced at exposures about $\frac{1}{2}$ those which excluded the species; and there is at present no clear relationship between the LD_{50}'s of laboratory studies and criteria useful in appraising effects on communities. (auth)

Metabolism, Tissue Distribution, and Toxicology

33736 (BNL-8360) COMPUTER CORRECTION OF BACKGROUND IN RADIOAUTOGRAPHY WITH TRITIATED THYMIDINE. Bresciani, F.; Thompson, K. (Naples Univ. (Italy). Istituto di Patologie Generale and Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 13p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

The use of ^{3}H-thymidine as a tracer in quantitative radiographic studies of DNA synthesis and cell population kinetics using liquid photographic emulsion is discussed. The presence of false labeled cells due to background grains in the developed autoradiogram was corrected using calculations carried out on the IBM 7094 computer. The computer program is available on request. (C.H.)

33737 (BNWL-SA-78) THE USE OF TISSUE CULTURE AND CYTOCHEMICAL TECHNIQUE IN TOXICOLOGIC RESEARCH. Clarke, W. J.; Palotay, J. L.; Mahlum, D. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1, 1965. Contract AT(45-1)-1830. 18p. (CONF-650113-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Western States Veterinary Conference, Las Vegas, Nev.

The advantages of using tissue culture and cytochemical techniques in toxicologic research are discussed. Analytical, microscopic, and cytochemical techniques are described. Applications of the techniques in a study of the early toxic action and carcinogenic properties of p-dimethylaminoazobenzene (DMAB) in rat liver are reported in detail. (C.H.)

33738 (N64-22756) RADIOISOTOPIC BIOCHEMICAL PROBE FOR EXTRATERRESTRIAL LIFE. Second Annual Progress Report. (Resources Research, Inc., Washington, D. C.). Mar. 26, 1963. Contract NASr-10. 152p. (NASA-CR-55318). $11.50(CFSTI).

Extensive laboratory investigations and field testing were conducted. The tests further substantiated the feasibility of the principle on which Gulliver (radioisotopic biochemical probe for extraterrestrial life) is based. Biological and instrumentation studies were pursued concurrently and interdependently. Gulliver III exhibited omnidirectional capability, importance as an antimetabolite injection system, and usefulness for flushing. This is a better technique for deploying sample collection lines. (auth)

33739 (N64-22793) RADIOISOTOPIC BIOCHEMICAL PROBE FOR EXTRATERRESTRIAL LIFE. Quarterly Progress Report No. 7. (Resources Research, Inc., Washington, D. C.). Dec. 10, 1962. Contract NASr-10. 31p. (NASA-CR-56532). $3.60(CFSTI).

Modifications of the medium were made that decrease the quantities of complex constituents. This was done by using yeast extract and peptone at concentrations of one-half those initially used and by completely removing the amino acid hydrolysate from the medium. These changes do not affect the present test cultures adversely and may be better for some of the facultative autotrophic organisms. Studies of the effects of several antimetabolites continued. Bard-Parker germicide can be heated at 135°C for 26 hours and still inhibit the range of test organisms without resulting in excessive sterile control levels. A working model of the instrument was developed that is capable of functioning without attitude control. Mechanical aspects of the field tests with the new instrument were satisfactory. The solid-state radiation detector used previously was replaced with an anticoincident geiger detection system. (auth)

33740 (NYO-2744-26) THE INHERITANCE AND CHARACTERISTICS OF DIFFERENTIAL ELEMENT ACCUMULATION BY MAIZE WITH PARTICULAR EMPHASIS ON STRONTIUM AND CALCIUM. Annual Progress Report. (Pennsylvania State Univ., University Park. Dept. of Agronomy). May 1965. Contract AT(30-1)-2744. 18p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Includes Appendices 1 through 4.

Progress is reported in experiments conducted in the field and in the greenhouse to evaluate the differential accumulation of cations, with emphasis on Ca and Sr, by several corn hybrids; to investigate the effects of chemical treatments of the soil on differential accumulation of cations; and to evaluate methods used to estimate cation availability from various soil types after various chemical treatments. Approximately 2,400 samples of plant material were analyzed spectrochemically for Ca, Sr, Mg, K,

P, Cu, B, Zn, Al, Mn, and Fe. Approximately 800 samples of plant and soil material were analyzed for Ca, Mg, K, and P. Data are reported from studies on the influence of genotype and environment on the level of accumulation of Ca, Sr, K, Mg, P, and Zn by hybrid corn plants and the effects of nitrogen fertilization on the accumulation of chemical elements, especially Ca and Sr, by several locally adapted corn hybrids. (C.H.)

33741 (UCRL-16053) MODELS OF BLOOD CELL PROLIFERATION. Nooney, Grove C. (Lawrence Radiation Lab., Univ. of California, Berkeley). Dec. 1964. Contract W-7405-eng-48. 22p. (CONF-641217-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From IBM Symposium on Scientific Computers, Yorktown Heights, N. Y.

The author discusses the maturative and proliferative behavior of the erythroid series and presents a mathematical model describing that behavior in terms of iron kinetics. Computational experience with the model is summarized. A discussion of the maturative and proliferative behavior and age distribution of the leukocyte series then is followed by the description of a new mathematical model of leukocyte kinetics. Simulation using the model and other means is suggested. (auth)

33742 DISTRIBUTION OF RADIOSTRONTIUM IN DEVELOPING BONES AND TEETH. MICROAUTORADIOGRAPHIC STUDY WITH ^{85}Sr. Hammarstroem, L.; Nilsson, A.; Ullberg, S. (Research Inst. of National Defence, Sundbyberg and Royal Veterinary Coll., Stockholm). Acta Radiol. Therapy, Phys., Biol., 3: 183-92(June 1965).

A method for dry-mounting tissue sections in microautoradiography is described. The distribution of ^{85}Sr in developing bones and teeth was studied up to sixteen days after a single intraperitoneal injection in albino rate. (auth)

33743 RETENTION OF ^{85}Sr IN RATS. I. EFFECT OF SODIUM, MAGNESIUM, CALCIUM, STRONTIUM AND BARIUM SULPHATES. Volf, Vladimir; Roth, Zdenek (Inst. of Radiation Hygiene and Inst. of Industrial Hygiene and Occupational Diseases, Prague). Acta Radiol. Therapy, Phys., Biol., 3: 216-28(June 1965).

The average retention of ^{85}Sr given orally decreased when various sulfates were administered immediately or ten minutes later. Excepting strontium sulfate there was no substantial difference in their effectiveness. When a combination of barium sulfate with sodium or magnesium sulfates was used, the results were significantly better than with each sulfate alone. (auth)

33744 UPTAKE AND EXCRETION OF CESIUM 137, POTASSIUM AND ZIRCON/NIOBIUM 95 IN CATTLE. Wegener, Hausken O.; Nygard, J. J. (Norwegian Defense Research Establishment, Kjeller, Norway). Acta Vet. Scand., 5: 331-46(1964).

Gamma spectrographic examinations were used to determine the uptake, and excretion of Cs-137, K, and Zr/Nb-95 in a dairy cow. At the end of the experiment the cow was slaughtered and measurements of parenchymatous organs were made. Cs-137 and Zr/Nb-95 in hay, straw, and silage are discussed in connection with crop per areal unit. (Excerpta Med.)

33745 CYTOLOGICAL MODIFICATIONS OF TROUT PITUITARY AS A RESULT OF AN IODINE DEFICIENCY AND A RADIOTHYROIDECTOMY. Olivereau, Madeleine; La Roche, Gilles; Woodall, A. N. (Inst. Oceanographique, Paris). Ann. Endocrinol. (Paris), 25: 481-90(Sept.-Oct. 1964). (In French)

Three-month old Salmo gairdnerii Rich. (rainbow) trout were put on a diet containing six μg I/gm food or a diet without I. After six weeks the fish received an injection of 100 μC ^{131}I every month. After five or six injections, several trout were killed and their thyroids and pituitaries compared to those of trout with I deficiencies and to normal trout. The thyroid of trout on a normal diet appeared normal, with an epithelial thickness of two to five μ and resorption vacuoles bordering the colloid region. In trout deficient in I, there was evident stimulation. In trout deficient for seven months, epithelial thickness was six to 12 μ or eight to 20 μ, and for eight months the thickness was four to eight μ. The colloid in the follicles was reduced, and there was marked peripheral vacuolation. Mitoses were present and the total volume of thyroid tissue appeared to have increased. After the fifth or sixth ^{131}I injection in the radiothyroidectomy trout, no intact follicles were seen. The thyroglobulin region was replaced by degenerating connective tissue surrounded by hemateinophilic cytoplasm. In the pituitary of trout given an I diet supplement the rostral pars distalis consisted mostly of follicles bordered by erythrosin-stained η cells and corticotropic ϵ cells. A third type of cell with a dia of eight to nine μ, nucleus of five μ, barely evident nucleolus, and cytoplasm when stained with aniline blue was, very likely, the thyrotrophic δ cell. In the proximal pars distalis of the same trout, there were δ cells and acidophilic cells stained with orange G, which appeared to correspond to α cells. The pars intermedia contained two types of cells: one with granulations stained by alizarin blue; and one which would not stain. The nuclei of both types had large nucleoles and were often undergoing mitosis. In the pituitary of trouts deficient in I, there was no typical modification of α, ϵ, or η cells. Mitoses were observed in α and ϵ cells of the pars intermedia. The intensity of stain and the number of δ cells were increased, and they were apparent in the proximal pars distalis. Cells of about the same size as δ cells, with larger granulations, possibly performed a gonadotrophic function. In the pituitary of trout which underwent radiothyroidectomy, the α and η cells remained active. (BBB)

33746 SOME ASPECTS OF RADON CONTAMINATION FOLLOWING INGESTION. von Doebeln, Wilhelm; Lindell, Bo. Arkiv Fysik, 27: 531-72(1965).

The retained radon after ingestion of radon-containing water constitutes a source of error in γ-spectroscopic determinations of the total radioactivity of the human body; it is also of interest from the point of view of radiation protection. It is shown by means of multicompartment analysis that some current interpretations of earlier measurements are erroneous. The literature on the subject is discussed and new total-body measurements performed on persons who have ingested water containing radon are presented. The radiation dose in different organs and tissues is computed and a maximal permissible concentration of radon in drinking water is derived. Own measurements of the radon content in drinking water from a number of places in Sweden are reported; these results are discussed from the point of view of radiation protection and compared with the known content in drinking water in other countries. (auth)

33747 QUANTITATIVE WHOLE BODY STUDIES ON THE DECORPORATION OF ABSORBED IODINE-131 BY ORAL APPLICATION OF IODIDE. Gabbe, E. E.; Heinrich, H. C. (Universitaet, Hamburg). Atomkernenergie, 10: 207-10(May-June 1965). (In German)

The whole-body elimination of absorbed ^{131}I by oral doses of iodide was quantitatively studied in rats with a 4 π-whole body radioactivity detector with liquid organic scintillator. Measurement of the whole-body ^{131}I retention gave better results than the estimation of only the ^{131}I thyroid uptake since it measures the ^{131}I retention in the intra- and extrathyroidal iodine pool. The depression of the percentage of oral ^{131}I test dose which is finally, with a biological half life of about 10 days, in metabolic equilibrium with the whole-body iodine pool was used for calculation of the ^{131}I elimination effect, which was obtained by the oral iodide doses. By time dependence studies it was demonstrated that the most efficient ^{131}I whole-body elimination was obtained when the iodide was administered up to four hours before or with the iodide. If at least 5 mg were applied ^{131}I whole-body elimination effects of about 93% were obtained. (auth)

33748 THE ^{32}P-LABELLING OF NUCLEOTIDES FROM A SOLUBLE ERYTHROCYTE MEMBRANE FRACTION FREE OF HAEMOGLOBIN. Ronquist, G.; Agren, G. (Univ. of Uppsala, Sweden). Biochem. J., 92: 29P-30P (July 1964).

The incorporation of ^{32}P-phosphate into human red cell ghosts was studied. A tris-glycylglycine buffer extract of human red cell ghosts washed with water was prepared,

and after isoelectric precipitation at pH 6.0 and removal of the precipitate, the solution was filtered through Sephadex G-200 columns. From 600 to 700 ml of packed red cells were used. The colorless protein fraction first eluted from the Sephadex columns was incubated with ^{32}P (0.1 mC/ml) at about 20°C for 4 hr in the presence of 1×10^{-4} M unlabeled Na_2HPO_4. Excess of free ^{32}P was removed by filtration through Sephadex G-25. Trichloracetic acid (TCA)-soluble nucleotides from human erythrocyte content were also prepared. The labeled ^{32}P-incorporating lipoprotein complex from about 600 ml of packed red cells was incubated for about 30 sec with TCA-soluble nucleotides from the content of the same volume of cells. The labeled nucleotide fractions were analyzed for P, ribose, and base constituents, or after a preliminary purification by paper ionophoresis, with scanning of the electrophorograms and elution of labeled spots with uv absorbancy. It was found that the two largest labeled uv absorbing peaks consisted of ATP (adenosine triphosphate) and GTP (guanosine triphosphate) respectively. Smaller amounts of labeled ADP (adenosine diphosphate) and GDP (guanosine diphosphate) were also observed. Further on a large labeled peak was eluted after GTP. When the lipoprotein complex had been rapidly frozen to −186° in liquid nitrogen before incubation with ^{32}P, then rapidly thawed, incubated with ^{32}P, and mixed with nucleotides as described above, it was not possible to observe any labeled nucleotide peaks in the eluate from the column chromatography. (BBB)

33749 CHORIONIC GONADOTROPIN AND THE THYROID FUNCTION. II. EXPERIMENTAL STUDIES ON THE INFLUENCE OF HCG ON UPTAKE OF ^{131}I BY THE THYROID AND THE ^{131}I PLASMA TEST IN BABOONS. Consolo, F.; D'Arrigo, A. (Universita, Messina, Italy). Boll. Soc. Ital. Biol. Sper., 40: 449-52(1964).

Results are reported from studies on the effects of gonadotropic hormones on the metabolism of ^{131}I in baboons. Data are included on the thyroid and blood plasma content of ^{131}I. (C.H.)

33750 STABLE STRONTIUM IN HUMAN BONE: GEOGRAPHICAL AND AGE DIFFERENCES IN THE UNITED KINGDOM AND THEIR CORRELATION WITH LEVELS OF STRONTIUM-90. Mole, R. H. (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Brit. J. Nutr., 19: 13-33(1965).

A reassessment was made of published data of other workers on stable Sr and ^{90}Sr in human bone. In different parts of Great Britain the mean ratio of stable Sr to Ca in adult human bones ranged from 240 to 475 μg/g. Extreme values were found even as close as 40 miles apart (Carlisle vs Westmorland). Perinatal levels of stable Sr were correlated with adult levels. An estimate of placental discrimination may be derived from the ratio perinatal level: adult level of about 0.7. The concentration of stable Sr in bones of children from two to five years old or more was not demonstrably different from that of adults except in one area, Carlisle. With the striking exception of London and southeast England, the change from perinatal to adult levels occurred in the 2nd year of life; there was no particular change during the first 9 months. In London and southeast England the pattern of change with age was quite different: there was a progressive rise in Sr level from shortly after birth to the end of the 1st year by which time adult levels were reached. It is concluded that geographical differences need to be taken into account when making physiological deductions about turnover of bone salt from changes with age in the level of stable Sr. When children in the southeast of England and the rest of the United Kingdom were compared, there seemed to be a broad inverse correlation between levels of stable Sr and of ^{90}Sr. Detailed analysis of perinatal results from one area suggested that the level of stable Sr in bone was somewhat higher in summer than in winter and somewhat higher in anatomically normal babies than in babies dying with gross congenital defects. However, ^{90}Sr showed the seasonal change only. It is commonly assumed that tissue levels of stable Sr depend merely on overall levels in food and drink and on physiologic factors which affect the discrimination between Sr and Ca. To explain the difference between southeast England and all other areas it is then necessary to assume that dietary levels of stable Sr were quite different since there can hardly be marked physiologic differences between children in different parts of the same small country. The dietary levels of stable Sr would have to be such that in the rest of England, Wales, and Scotland the change in level with change in composition of the diet during the 1st year of life just neutralized the changes in physiological discrimination in intestine and kidney which are believed to occur at this time. Nearly 40% of the daily intake of stable Sr in the national diet is believed to come from the chalk which is added to flour from which bread is baked. No information was available about possible regional variations. Water for drinking and cooking accounts for one-seventh of the Sr intake, so that very large variations in Sr level in water would be needed to account for the observed differences in bone level of more than 50%. It is suggested that it may be incorrect to use changes in stable Sr levels with age as evidence for changes in such physiologic phenomena as discrimination in intestinal absorption between Ca and Sr or in rates of turnover of bone salt in the skeleton. Similarly, the geographical differences in levels of ^{90}Sr and in its specific activity need to be taken into account if changes in ^{90}Sr levels with age are to be used to deduce information on the metabolism of bone salt and the turnover of the skeleton. (BBB)

33751 STUDIES ON HUMAN GROWTH HORMONE. II. THE EFFECT OF HUMAN SERUM ON GROWTH HORMONE LABELED WITH RADIOACTIVE IODINE. Hadden, David R.; Prout, Thaddeus E. (Johns Hopkins Univ., Baltimore). Bull. Johns Hopkins Hosp., 116: 122-31(Feb. 1965).

Radioiodinated human growth hormone (HGH) was freshly prepared using both Wilhelmi-HGH (alkaline-extracted) and Raben-HGH (acid-extracted). Labeled products of high radioactivity (138 μC/μg) and of low radioactivity (17.6 μC/μg) were produced with each of these hormone preparations. HGH of low and high radioactivity was incubated with normal serum for 48 hr at 5°C and subjected to immunoelectrophoresis and subsequent autoradiography. The antiserum used was rabbit anti-human serum. The effect of serum on these HGH preparations, ^{131}I-labeled with high and low levels of radioactivity, was investigated. Hormone of high radioactivity was attached to several serum proteins and this material was not removed by incubation with antibodies to HGH. In contrast, HGH of low radioactivity was bound to α_2-macroglobulin, but could be removed from this attachment by anti-growth hormone antibodies. The significance of the reaction between α_2-macroglobulin and growth hormone is not entirely clear, but this reaction may account for the nonspecific inhibition found in some assay systems for HGH. It is possible that only radio-HGH that has been damaged, either by proteolytic activity, or as a result of radiation, is likely to be attached to serum proteins. This could account for some of the experimental results noted when radio-HGH of high activity was used. In these instances, nonspecific protein labeling was evident and there was some loss of immunologic identity between the radioiodinated peptide of high specific activity and unlabeled HGH. However, in the studies with radio-HGH of low radioactivity, radiation damage appeared to have been excluded, on the basis of immunologic studies. (BBB)

33752 NITROFURAN DERIVATIVES AS RADIOMIMETIC AGENTS: CROSS-RESISTANCE STUDIES WITH ESCHERICHIA COLI. McCalla, D. R. (McMaster Univ., Hamilton, Ont.). Can. J. Microbiol., 11: 185-91(Apr. 1965).

Nitrofurazone is a mutagen and a radiomimetic agent. Since radiation and radiomimetic chemicals (e.g., nitrogen mustards and other alkylating agents, proflavin, and mitomycin C) are thought to exert their effects by damaging DNA, a study was conducted to determine whether other Schiff's base nitrofurans and NFT are also radiomimetic. NFT is 3-amino-6-[2-(5-nitro-5-furyl)vinyl]-1,2,4-triazine. Survival curves were determined by irradiating about 5×10^8 stationary phase cells suspended phosphate buffer. Mutants of E. coli B selected on the basis of resistance to nitrofurazone, NFT, or uv light proved to be resistant to

all three of these agents. Further tests showed that these mutants were also resistant to three other nitrofuran derivatives, nitrofurantoin, nihydrazone, and furazolidone, but not to nifuroxime. The mutants were also resistant to the chemically dissimilar radiomimetic agent, proflavin. Strain B and all the mutants derived from it are equally sensitive to streptomycin, a nonradiomimetic antibiotic. E. coli strain B/r (resistant to radiation and radiomimetic chemicals) showed the same resistance known concerning the basis for the resistance of strain B/r to uv light. Since postulated mechanisms of resistance involve repair of lesions produced in the DNA by uv light, the most reasonable conclusion which can be drawn from the finding that some nitrofuran derivatives are radiomimetic is that these compounds damage DNA in such a way that the damage can be repaired by a system which repairs uv photodamage. The actual lesions introduced by nitrofurans may be quite different from those caused by other radiomimetic agents. Strain B/r is about 15 times as resistant to nitrofurazone, nitrofurantoin, or nihydrazone as is strain B but only four times as resistant to NFT, suggesting that the action of NFT is different from that of the three Schiff's bases. Other evidence for such a difference is provided by the earlier finding that while NFT induces prophage development, nitrofurazone and nitrofurantoin do not. (BBB)

33753 UPTAKE OF ^{85}Sr BY CEREAL CROPS AND VARIETIES. Lee, C. C.; Sosulski, F. W. (Univ. of Saskatchewan, Saskatoon, Canada). Can. J. Plant Sci., 45: 13-17(Jan. 1965).

Radioassays were made on the whole plant, leaf, stem, chaff, and seed of 29 varieties of wheat, oats, barley, and rye grown to maturity in a greenhouse on Oxbow loam treated with ^{85}Sr. Based on the average uptake of ^{85}Sr per g of whole plant material, the ranking of the cereal crops in order of decreasing ^{85}Sr uptake was rye, barley, oats, and wheat. Significant differences in ^{85}Sr uptake between varieties within crops of wheat, oats, and barley were demonstrated. The range of values for varieties within crops overlapped those of other crops, the variability being greater in wheat and barley than in oats. These results suggest that the validity of assessing differences between crops on the basis of single varieties to represent each crop may be questionable. Leaves accumulated the highest percentages of ^{85}Sr and gave good prediction of the precentage uptake by the whole plant. Lesser quantities of ^{85}Sr were found in the seeds and these values were unrelated to ^{85}Sr levels in the vegetative plant parts. Seeds of wheat, barley, and rye, which are commonly utilized as human food, were similar in range of ^{85}Sr uptake but dehulled oat seeds were consistently higher in the accumulation of this element. Since the chaff of oats and barley showed much greater ^{85}Sr uptake than the seeds, commercial grain of these crops may constitute a more serious potential hazard to livestock than cereals which are free-threshing. It was noted that several of the more popular varieties in Western Canada ranked relatively high in ^{85}Sr accumulation. Varieties that were relatively low in accumulation of ^{85}Sr in the whole plant and seed were Idaed and Rescue wheat, Rodney oats, and Keystone and Vantage Barley. (BBB)

33754 FILTERABLE AND NON-FILTERABLE SERUM COPPER. 2. STUDIES WITH ^{64}Cu. Osborn, S. B.; Walshe, J. M. (King's Coll. Hospital, London). Clin. Sci., 26: 213-17(Apr. 1964).

A study was made of the partition of radiocopper that occurs in the serum in vivo up to 24 hr after administration, using a radiochemical technique that was expected to yield more information than purely in vitro methods or the chemical procedures. Four patients with Wilson's disease, one heterozygote and four normals, were given ^{64}Cu intravenously in doses varying from 84 to 128 μC. Plasma obtained at two and 24 hr was subjected to ultrafiltration with or without the addition of penicillamine. Two normals and two Wilson's disease patients received penicillamine by mouth at two hr; plasma was sampled 1.5 hr later. In the normal subjects very little radioactivity was filtered at two or 24 hr in the absence of penicillamine. The addition of penicillamine greatly increased the ^{64}Cu availability for filtration at two hr; there was a slight increase at 24 hr. The serum of two of the Wilson's disease patients allowed very little ^{64}Cu to filter at two or 24 hr; in the other two patients the filtration fraction for ^{64}Cu varied from 25 to 59%. The addition of penicillamine to the plasma allowed from 66 to 100% of the Cu to pass the membrane at both two and 24 hrs. Oral administration of penicillamine caused a slight increase in the filterable ^{64}Cu. The serum from the heterozygous individual behaved like Wilson's disease serum at two hr, but like normal serum at 24 hr. In general, these results confirmed those obtained by routine chemical techniques but went further in that they demonstrated that the change in the nature of the Cu-protein bond which occurs in normal and in heterozygous individuals between two and 24 hrs after administration of radiocopper, but appears not to take place in patients with Wilson's disease. It is clear that the bond between Cu and albumin is very much less strong than that between Cu and the protein moiety of ceruloplasmin. The failure of Cu incorporation into this protein presumably accounts for the greatly increased lability of the plasma Cu in Wilson's disease and appears to permit not only the increased excretion of Cu in the urine but also the ability of the metal to combine with intracellular proteins which have a high affinity for Cu. (BBB)

33755 QUANTITATIVE STUDIES OF IODINE METABOLISM IN IODIDE-TREATED THYROTOXICOSIS. Hardin, R. McG.; Koutras, D. A.; Alexander, W. D.; Wayne, E. J. (Gardiner Inst., Western Infirmary, Glasgow). Clin. Sci., 27: 399-405(Dec. 1964).

Measurements were carried out in 17 thyrotoxic patients before and two and four weeks following iodide administration included: serum protein-bound iodine (PBI); 2½ hour thyroidal ^{132}I uptake; thyroidal ^{132}I clearance rate; plasma inorganic iodine (PII) concentration; absolute iodine uptake (AIU) by the thyroid in μg/hr; and renal ^{132}I clearance. These quantitative studies of iodine metabolism were performed before and after continuous administration of 0.83 mg potassium iodide four times daily to 7 thyrotoxic patients and of 3.3 mg four times daily to 10 thyrotoxic patients. In the former group the clinical effect was inconsistent. In the second group a clinical improvement and a fall in the PBI to normal levels were noted at 2 weeks. Most patients had, however, relapsed after 4 weeks of continued treatment. Estimation of the AIU by the thyroid in μg/hr showed that, even at the time of maximal effect, the thyroid continued to accumulate excessive amounts of iodide, in spite of the drop in PBI. After iodide treatment, perchlorate administration produced a discharge of thyroid radioactivity, which suggests that the dissociation between the amounts of iodide trapped and secreted by the thyroid is due mainly to faulty conversion of iodide to thyroid hormone. There was no evidence that the radioiodine uptake in thyrotoxicosis is more easily suppressed by exogenous iodide than in normal controls. The minimum effective dose of iodide for the treatment of thyrotoxicosis is of the order of 10 mg a day (equivalent to 13 mg of potassium iodide). (BBB)

33756 COMPARISON OF THE EFFECTS OF THIOURACIL, PROPYLTHIOURACIL, AND METHIMAZOLE ON ^{131}I METABOLISM BY THE CHICK THYROID AND MEASUREMENTS OF THYROXINE SECRETION RATES. Tanabe, Yuichi; Komiyama, Tetsuro; Kubota, Daisaku; Tamaki, Yoshinori (National Inst. of Animal Industry, Chiba, Japan). Gen. Comp. Endocrinol., 5: 60-8(Feb. 1965).

Thiouracil, propylthiouracil, and methimazole, when fed to 5-week-old cockerels at a 0.1% level in the diet, creased thyroid ^{131}I uptake to 62, 21, and 13% of that of a normally fed group, respectively. When fed at a 0.1% level in the diet, they increased the release rate of thyroidal ^{131}I to 2.4, 3.4, and 4.1 times, respectively, that in the chick fed a normal diet. In addition, similar values, about 1.5 μg/100 g body weight per day, were obtained in the estimation of the thyroxine secretion rate of 5-6-week-old cockerels both by the goiter prevention assay

and by the radioiodine assay with thiouracil, propylthiouracil, or methimazole as the goitrogen. The results of both assays revealed that the doses of the goitrogens used had little effect on thyroxine secretion rates in 6-7-week-old cockerels. Thiouracil feeding at a 0.1% level in diet of 9-week-old cockerels, which had fecal fistulas for the separate collection of the urine and feces, increased (20 to 30%) fecal excretion and decreased (by 10%) the deiodination of thyroxine-^{131}I compared with the nongoitrogen-treated birds. The feeding of methimazole had no such effects. The feeding of potassium perchlorate to the 13-week-old cockerels having fecal fistulas, at a 1% level in diet, severely inhibited the thyroid uptake of ^{131}I recycled from metabolized radiothyroxine, but it did not increase fecal excretion of radiothyroxine. Administration of propylthiouracil to these birds increased fecal excretion by 30%, and it decreased the deiodination of radiothyroxine by 15%; methimazole had no effect. Thus, although methimazole has a stronger antithyroidal activity than thiouracil, it does not increase the fecal excretion of thyroxine as thiouracil does in the chick. The rate of thyroxine secretion is not affected by the different goitrogens. (BBB)

33757 EFFECTIVENESS OF AURIN TRICARBOXYLIC ACID (ATA) AS AN ANTIDOTE FOR BERYLLIUM POISONING. King, Maurice E.; Shefner, Alan M.; Ehrlich, Richard (Illinois Inst. of Tech., Chicago). Ind. Med. Surg., 33: 566-9(Aug. 1964).

Preliminary to studies on the effectiveness of ATA in monkeys and dogs as an antidote for Be poisoning, the acute intravenous LD_{50} was determined. The LD_{50} and standard error determined by probit analysis were 344 ± 20.3 mg/kg for monkeys and 164 ± 13.5 mg/kg for dogs. The value for monkeys is similar to the 340 ± 8 mg/kg reported in rats but is less than the value of 600 mg/kg for mice. In chronic ATA toxicity experiments, two dogs and two monkeys were given weekly intravenous injections of 10 and 25 mg ATA/kg, respectively, for eight months. These extended ATA doses produced no toxic effects, but two monkeys given weekly ATA injections of 50 mg/kg began to lose weight and abscesses were observed on their legs near the site of injection. One monkey died after 14 and the other after 16 weeks. Fatty metamorphosis of the liver cells was found. To establish the lethal dose of beryllium sulfate, monkeys and dogs were given this compound (0.2 to 0.8 mg/kg as Be) intravenously. Death generally occurred within three days, doses above 0.6 mg/kg being fatal to both species. Intratracheal injection of $BeSO_4$ was used to simulate inhalation of soluble Be compounds. As with the intravenous injections, most deaths occurred within three days. The response of the two species, however, was different, LD_{50} values were 1.5 mg/kg in monkeys and 2.0 mg/kg in dogs. Subsequent experiments were based on intratracheal doses of 2 mg/kg for monkeys and 3 mg/kg for dogs. Pathological examination revealed congestion and the fatty degeneration of the liver, just as obtained upon intravenous administration, but lung damage was more extensive. The alveolar lumina and septa contained areas of diffuse hemorrhage and some foci of necrosis. Thickening of the septa and scattered lymphocytic infiltration were also found. Other results indicated that high doses of BeO did not produce acute toxicity when administered intravenously or intratracheally. However, the lung and liver pathology suggest that the animals might have died from toxic effects eventually. Dogs and monkeys were injected intravenously with ATA in doses ranging from 0 to 200 mg/kg one hr after $BeSO_4$ in doses ranging from 0 to 1.0 mg/kg was administered, and the mortality was observed for seven days. The results showed that 50 mg ATA/kg reduced mortality in monkeys at all Be doses. The LD_{50} for Be with 50 mg ATA/kg was 0.87 mg/kg as compared with 0.63 mg/kg for the untreated monkeys, this difference being significant. To be effective in monkeys, ATA must be given within one hr after Be injection. It is concluded that ATA treatment affords some protection against Be poisoning in monkeys but not in dogs. (BBB)

33758 THE ACCUMULATION AND RETENTION OF STRONTIUM-90 IN PERMANENT HUMAN TEETH IN THE UNITED KINGDOM. Starkey, W. E.; Bryant, F. J.; Henderson, E. H. (Royal Naval Medical School, Alverstoke, Eng.). Intern. Dental J., 14: 206-25(June 1964).

Results of a survey by the Royal Navy of ^{90}Sr accumulated in human teeth are described. This investigation was confined to perfect teeth which have formed since 1953; namely, premolars from persons 9 to 13 yr old, and third molars from persons 17 to 21 yr old. These are the ones most commonly removed without being decayed. Roots and crowns were divided, bulked according to age groups, and analyzed separately. Separate estimations were made of material gathered from regions with more than 40 in. mean annual rainfall and results were obtained for 4500 specimens collected from all parts of the United Kingdom during the period autumn 1959 to autumn 1962. The results showed that ^{90}Sr in different portions of the tooth are related to the rate of ingestion during development: crowns in older children had low values because they were mainly formed before 1953; roots, formed subsequently, had higher values reflecting rising dietary levels. Amounts of ^{90}Sr in the teeth of corresponding age groups rose year by year, and at any given time were highest in the youngest children. Values also increased annually in cohorts of individuals with the same year of birth. In areas of heavy rainfall values were consistently higher than over the rest of the country. Discrimination against Sr in relation to Ca was similar in developing dental tissues to that previously found in bone. Concentrations of stable Sr were marginally lower in the teeth than in bone during childhood and adolescence. This would be expected with rising levels of Sr in the diet, provided that the rate of uptake in tooth and bone was the same. It was found with teeth and bones developed in utero (and therefore sharing a common level of contamination from the maternal plasma) that the ^{90}Sr/Ca ratio was the same. Since the uptake of ^{90}Sr by bone is related to levels in the plasma, it is concluded that terminal burdens in the teeth will always correspond with the level of ^{90}Sr that existed in the plasma when tooth substance was first laid down. There is no evidence that the observed levels of contamination are in any particular danger to the public health, but consideration is given to how the radiation dose absorbed by adjacent tissues is liable to vary between tooth and bone. Even with similar ^{90}Sr/Ca ratios in both, there are structural distinctions affecting the total quantity of energy released into the immediate vicinity. More than one third of the tooth is composed of calcium compared with about one seventh in bone. With equivalent values the amount of ^{90}Sr/g of tooth is greater than the amount of ^{90}Sr/g of bone by a factor of about 2.3. Moreover, the density of bone is less than the density of dentin and enamel. Thus the concentration of ^{90}Sr in unit volume of the tooth is greater than the concentration for the same volume in bone. Since the range of irradiation is limited to about six mm through bone, the radiation dose depends on the volumetric concentration of ^{90}Sr within a circumscribed radius. With rising levels of fission products in the diet the highest values would normally be found in bone. Under stable conditions sp act. in bone and tooth would be the same (although activity per unit volume would be highest in the latter). But if the level of ^{90}Sr in foodstuffs should decline or disappear, then earlier concentrations in the teeth would persist at the levels originally laid down and, after the passage of time, might be higher than concentrations in the rest of the skeleton. (BBB)

33759 ANALYSIS OF DISTRIBUTION OF ^{45}Ca IN DOG BONE BY A QUANTITATIVE AUTORADIOGRAPHIC METHOD. Jowsey, Jenifer; Lafferty, W.; Rabinowitz, J. (Albert Einstein Medical Center, Philadelphia). J. Bone Joint Surg., 47A: 359-70(Mar. 1965).

A new method of quantitative autoradiography was developed which permits quantitation of the amount of radioactivity in a given area of bone and allows for discrimination between radioisotope retained by different mechanisms. An investigation was made to find out what proportion of a tracer dose of ^{45}Ca is retained in the skeleton as the result of bone formation and what proportion as the result of other processes, that is, the proportions of radioisotope localized in hot spots and in

diffuse deposits. The results clarify the usefulness of kinetic studies as a method for measuring bone formation. Beagle dogs, nine months to ten yr old, were each given intravenously 150 μC of ^{45}Ca (sp act. 10 mC/mg as $CaCl_2$ in H_2O) per kg of body weight. Samples of blood were taken at intervals, to show the rate of disappearance of ^{45}Ca from the blood, and 24 hr after injection of ^{45}Ca the right hind limb of each dog was amputated. Three weeks after injection of the tracer the dogs were killed and the other femur was removed. Each dog was given tetracycline intravenously a day before the injection of ^{45}Ca and again two days before it was killed. Tetracycline is deposited in new bone and is seen as a bright ring of fluorescence in uv light so that all bone formed during the period between injections could be identified. For quantitative autoradiography, standards were exposed to the same autoradiographic plate as the bone sections. The standards consisted of plaster of paris mixed with ^{45}Ca in an amount corresponding to the expected range of sp act. of the bone sections. Transparencies were made of the autoradiographic plates, and the blue dye from these, representing exposed portions, was extracted by n-butyl acetate after digestion of the gelatin film with trypsin. The amount of dye was then estimated photometrically, the readings being calibrated in terms of μC of ^{45}Ca by the standard films. The rate of disappearance of ^{45}Ca from the blood was most rapid in the youngest and least rapid in the oldest dog. In the nine-month-old dog more than half of the tracer was associated with bone formation, both at 24 hr and at three weeks after injection, while in the two-and-one-half-yr-old dog this was true of only a fifth of the ^{45}Ca. In a ten-yr-old dog, there was a return toward the pattern shown by the young dog, although still less than 50% was associated with bone formation. Quantitative measurement of the amount of cortical and trabecular bone in an adult dog's skeleton showed that about 30% by weight or volume of the skeleton is trabecular and 70% is cortical bone. It is concluded that this method is useful to measure the total amount of darkening in a chosen area of an autoradiograph. The blueness in the developed film is proportional to the amount of energy hitting autoradiographic emulsion, and, therefore, assuming that the bone has a constant composition, the blueness is proportional to the amount of ^{45}Ca tracer in the bone. The method allows quantitation of an area of an autoradiograph of any shape or size and depends on a built-in reference system, the ^{45}Ca-plaster of paris radiation sources, which allows quantitation and correction for variations in exposure times and processing. (BBB)

33760 THE EFFECT OF HYPERGLYCEMIA ON HYPOTHALAMIC GOLD UPTAKE AND HYPERPHAGIA IN GOLDTHIOGLUCOSE-TREATED MICE. Edelman, P. Michael; Schwartz, Irving L.; Cronkite, Eugene P.; Brecher, George; Livingston, Linda (Brookhaven National Lab., Upton, N. Y.). J. Exptl. Med., 12: 403-13(Mar. 1, 1965).

Neutron activation analysis, measuring ^{198}Au, was used to investigate the accumulation of Au in the hypothalamus, and the development of hyperphagia and obesity was studied in mice given a single intravenous injection of goldthioglucose at various levels of blood glucose concentration. It was found that the glucose concentration prevailing at the time of goldthioglucose injection was correlated directly with the level of free and bound goldthioglucose in the blood 3 min later, with the hypothalamic uptake of Au, with the extent of the hypothalamic lesion, and with the severity of the subsequent hyperphagia and obesity. Hyperglycemia was associated with an increased Au deposition throughout the brain. An Au content of 88 ± 12 μg/mg wet tissue in the hypothalamus of fasted animals was associated with clear-cut lesions in all animals studied, whereas a similar Au content in the control brain lobes of hyperglycemic animals was not associated with lesions in any animal. This finding indicates that some regions in the brain (e.g. the ventral hypothalamus) are more susceptible than others to damage by goldthioglucose. (auth)

33761 THE ABSORPTION AND LOSS OF RADIOACTIVE AND NON-RADIOACTIVE MANGANESE BY THE LOBSTER, HOMARUS VULGARIS. Bryan, G. W. (Plymouth Lab., Eng.) and Ward, Eileen. J. Marine Biol. Assoc. U. K., 45: 65-95(1965).

A study was made of the concentrations of Mn in lobster tissues under different conditions and of the way in which Mn can be obtained either from food or directly from sea water. In addition, experiments were carried out using ^{54}Mn as a tracer. This nuclide (half-life = 291 days) is of interest because it is a neutron-induced nuclide produced as a result of nuclear-weapon tests. It may also reach the sea in small quantities as waste from nuclear reactors. This work on the metabolism of Mn in the lobster was designed to show, therefore, which environmental conditions are likely to affect the accumulation and loss of ^{54}Mn. In the internal tissues of the fresh animal, muscle contains 0.5 to 1.1 μg/g wet tissue, hepatopancreas 4.1 to 5.7 μg/g, excretory organs 2 to 5.5 μg/g, and blood 1.4 to 3.8 μg/g Mn. Gill Mn concentrations are very variable and up to 30 μg/g are found. About 98% of the Mn lies in the calcified exoskeleton. Concentrations in the carapace are variable (100 to 300 μg g of wet tissue). Manganese is lost from the blood during starvation and is absorbed so slowly from solution in sea water so that normally an appreciable amount of the body Mn must be absorbed from food. Absorption from the stomach takes place via the hepatopancreas and the amount absorbed appears to be proportional to the Mn concentration of the stomach fluid. Similarly, there is no evidence that the slow absorption of Mn from solution in sea water across the gills can in any way be controlled and it may be a passive process. Experiments with ^{54}Mn in unfed lobsters showed that Mn losses take place by urinary excretion (20 to 40%), across the body surface (40 to 80%) and via the anus (up to 20%). Losses of Mn from the body can in some degree be controlled by changing the efficiency of these processes. For example, in animals loaded with excess Mn the urine/blood ratio is increased. As a result, ^{54}Mn is lost more rapidly from Mn-loaded animals than from normal animals. Some absorption and release of Mn by the shell may take place which assists in controlling the blood and tissue Mn concentrations. Injection of 50 mg of EDTA, as the disodium salt, into the blood produces an increase in the rate of loss of ^{54}Mn from the whole animal. This, partially at least, involves an increase in the urinary excretion of ^{54}Mn. (BBB)

33762 IONIC REGULATION IN THE SQUAT LOBSTER GALATHEA SQUAMIFERA, WITH SPECIAL REFERENCE TO THE RELATIONSHIP BETWEEN POTASSIUM METABOLISM AND THE ACCUMULATION OF RADIOACTIVE CESIUM. Bryan, G. W. (Plymouth Lab., Eng.). J. Marine Biol. Assoc. U. K., 45: 97-113(1965).

This work formed part of a survey made to find whether any marine invertebrates were able to accumulate Cs to a particularly high degree. Such a species might produce a hazard if the fission product ^{137}Cs (half life = 30 yr) were present in the sea water either as a result of the disposal of radioactive waste or as a result of weapon tests. Generally, the small amount of Cs in sea water (0.37 μg/l) can be concentrated in most of the tissues of marine invertebrates by factors which are higher than those for K. Thus ^{42}K, ^{134}Cs, and ^{137}Cs were used to study the absorption of Cs from sea water in relation to K metabolism, and a general study was made of the ability of Galathea to carry out osmotic and ionic regulation in comparison with better known decapod crustaceans, previously used for radioactive Cs experiments. Galathea appears to be a truly marine decapod in that it is probably unable to osmoregulate and the body surface is very permeable to water and to Cs and K ions. Despite this high permeability, Galathea is able to regulate K and Cs at blood plasma levels which are 1.3 and 1.1 times those of sea water. The Na and Cl concentrations in the plasma are not regulated and the Ca concentration is variable, but Mg and SO_4 are maintained at concentrations below those of sea water. Urinary excretion does not assist in the conservation of K or radioactive Cs in the plasma but

assists in removing Mg and SO_4. Regulation of K in plasma and muscle tissue also occurs in low K sea water and causes the whole-animal equilibrium concentration factors which can be attained by ^{42}K absorption to be increased (e.g. from 4.5 in sea water with 12 mM/kg of K to 7.5 in sea water with 6 mM/kg of K). Radioactive Cs is absorbed far more slowly than ^{42}K, but higher concentration factors are usually reached. Both ions penetrate the body surface rapidly, but the tissues constitute the limiting factors in uptake by the whole animal. Losses of both radioactive Cs and K take place chiefly across the body surface and losses due to urinary excretion are negligible, although the equivalent of about 15% of the body weight is excreted per day. Comparative results in other marine invertebrates are discussed. (BBB)

33763 DISTRIBUTION OF ^{99m}Tc AND TUMOR/BRAIN CONCENTRATIONS IN RATS. Matthews, C. M. E.; Mallard, J. R. (Hammersmith Hospital, London). J. Nucl. Med., 6: 404-8(June 1965).

The distribution of ^{99m}Tc as pertechnetate was measured in rats and found to be similar to that of ^{131}I as iodide, except for higher concentrations of ^{99m}Tc in liver, kidney and gastrointestinal tract. Mean tumor/brain concentration ratio for two different transplanted rat sarcomata was 12 for ^{99m}Tc compared with 11 for ^{131}I. (auth)

33764 A SIMPLE METHOD OF PRODUCING ^{18}F FLUORIDE FOR THE STUDY OF BONE DISEASE. Nusynowitz, Martin L. (Walter Reed Army Institute of Research, Washington, D. C.) Feldman, Milton H.; Maier, John G. J. Nucl. Med., 6: 473-80(July 1965).

A simple method for the production of sterile, pyrogen free, carrier free ^{18}F fluoride is described. Under the conditions of production, specific activities of 0.9 μC per gram 11.2 per cent ^{18}O enriched water resulted. A small amount of ^{24}Na was also present and methods for preventing the formation of this impurity are suggested. Its presence did not interfere with the use of the ^{18}F fluoride. Intravenously administered ^{18}F fluoride is rapidly cleared from the blood. By four hours, 44 per cent of the administered dose appears in the urine; this represents almost the total urinary excretion of isotope. It is believed that nearly all the unexcreted fluoride is bound to bone. The possible applications of ^{18}F fluoride in clinical medicine are discussed. (auth)

33765 NONDIALYZABLE MANGANESE, COPPER AND GOLD LEVELS IN SALIVA OF NORMAL ADULT SUBJECTS. Kanabrocki, Eugene L.; Case, Lawrence F.; Fields, Theodore; Graham, Leonard; Miller, Edwin B.; Oester, Yvo T.; Kaplan, Ervin (Veterans Adm. Hospital, Hines, Ill, and Loyola Univ., Chicago). J. Nucl. Med., 6: 489-93(July 1965).

Saliva samples from 21 apparently normal adult human subjects were analyzed for trace elements using the neutron activation technique. All samples contained nondialyzable copper, manganese and gold in the following concentrations. Evidence indicates that copper, manganese and gold are carried in saliva as nondialyzable metallo-complexes. The level of nondialyzable copper found in this study is comparable with the concentration of total salivary copper reported in the literature. (auth)

33766 THE DISTRIBUTION, METABOLIC FATE AND RADIATION DOSIMETRY OF ^{131}I LABELED MACROAGGREGATED ALBUMIN. Furth, Eugene D.; Okinaka, Arthur J.; Focht, Elizabeth F.; Becker, David V. (New York Hospital-Cornell Medical Center, New York). J. Nucl. Med., 6: 506-18(July 1965).

To determine the amount of radiation delivered to the lungs and whole body during lung scanning, the kinetics of body disposal of the ^{131}I labeled macroaggregated albumin (MAA) was studied. MAA labeled with ^{131}I was found to be heterogeneous with regard to particle size, denaturation, distribution, and rates of disappearance from various organs and the body. In man, about 87 percent is trapped in the lung, and 13 percent is initially distributed in the plasma space. MAA ^{131}I disappears from the lung and blood in a multi-exponential fashion. The mean biological half-time of disappearance from lung is 0.25 days for the rapid component and 3.2 days for the second component. The rapid blood component has a mean biological half-time of 0.44 days and a second component of 4.0 days. A third and even slower component is possible. It is concluded that the radiation dose to the lungs for 300 μC is 1.9 rad, the whole body radiation dose being 0.008 rad. (H.G.D.)

33767 ZINC-65 ABSORPTION AND TURNOVER IN RATS. I. A PROCEDURE TO DETERMINE ZINC-65 ABSORPTION AND THE ANTAGONISTIC EFFECT OF CALCIUM IN A PRACTICAL DIET. Heth, D. A.; Hoekstra, W. G. (Univ. of Wisconsin, Madison). J. Nutr., 85: 367-74(Apr. 1965).

A whole-animal scintillation counter was used to follow ^{65}Zn excretion in growing rats of the Holtzman strain which were fed a standard diet to which ^{65}Zn was added as the chloride or glycine complex. Other rats were injected intramuscularly with ^{65}Zn-glycine in doses of 0.5 to 1.5 μC per animal. Rapid fecal excretion of ^{65}Zn occurred following administration via feed or gavage. Increased dietary Ca significantly increased the initial rate of ^{65}Zn loss following oral administration and consistently and significantly decreased the percentage remaining in the body longer than two days. Conversely, body loss of injected ^{65}Zn decreased significantly with increased Ca. Comparison of retention curves at 100 to 250 hours postadministration for injected and dietary or gavage-administered ^{65}Zn and their extrapolation to zero time allowed the determination of the percentage of radiozinc absorbed. Calcium significantly decreased the percentage of ^{65}Zn absorption and increased the biological half-life (decreased turnover) of ^{65}Zn beyond 100 hours postadministration. Calcium did not affect body weight. The results are explained by a decreased absorption of stable and radiozinc with increased dietary Ca. Calcium also significantly increased carcass ^{65}Zn in the femur and decreased it in liver, kidney, and muscle at 28 days postadministration. The factor in the corn-soybean diets which interferes with Zn absorption in the presence of Ca has been speculated to be phytic acid. However, it was not possible to decrease the absorption of oral ^{65}Zn in rats by the addition of phytic acid to purified diets containing animal proteins or protein hydrolysates. (BBB)

33768 ABSORPTION OF ^{64}Cu, ^{65}Zn, ^{99}Mo, AND ^{59}Fe FROM LIGATED SEGMENTS OF THE RAT GASTROINTESTINAL TRACT. Van Campen, Darrell R.; Mitchell, Elizabeth A. (U. S. Dept. of Agriculture, Ithaca, N. Y.). J. Nutr., 86: 120-4(June 1965).

Portions of rat intestinal tract were ligated to provide the following isolated, in vivo segments: stomach, duodenum, mid-section, or ileum. In successive studies, ^{64}Cu, ^{65}Zn, ^{59}Fe, or ^{99}Mo was injected into one of the ligated segments. After a predetermined period of time, the rats were killed and tissue samples were taken for isotope analysis. On the basis of these tissue counts, the following relative rates of absorption were indicated. For ^{64}Cu, absorption was greatest from the stomach and declined as the isotope was placed further away from the pylorus. In contrast, ^{65}Zn and ^{59}Fe were taken up most rapidly from the duodenum, somewhat more slowly from the ileum and the mid-section, and with the least absorption occurring from the stomach. The ^{99}Mo was absorbed readily from the stomach and all three intestinal segments. Absorption from the three segments was at similar rates and all three yielded significantly higher rates than the stomach. Direct comparisons between the various isotopes are difficult to make because of widely different rates of absorption. This difficulty can be alleviated by comparing ratios rather than absolute values. For each isotope, the ratio of uptake from a given segment of small intestine to uptake from the stomach was calculated. The ratios ranged from less than one, in the case of ^{64}Cu, to over 100 for ^{65}Zn. For ^{65}Zn, ^{99}Mo, and ^{59}Fe qualitatively similar absorption patterns were seen; namely, duodenum > ileum > mid-section > stomach; however, comparison of the ratios for these elements indicates that they are quantitatively different. (BBB)

33769 ALIESTERASE AND LIPASE ACTIVITY IN MOUSE KIDNEY IN THE COURSE OF EXPERIMENTAL INTOXICATION WITH URANYL NITRATE (BIOCHEMICAL AND HISTOCHEMICAL STUDY). Alibert, A.; Melet, P.; Bastide, P.; Turchini, J.-P.; Dastugue, G. (Faculte Mixte de Medecine et de Pharmacie, Clermont-Ferrand, France). J. Physiol. (Paris), 56: 272(May-June 1964). (In French)

Mice were given intraperitoneal injections of uranyl nitrate (400 mg/20 g body weight). Tests were made on liver homogenates at 0, 24, 48, 72, and 96 hr after injection on the activity of naphthylacetate and bromo-indoxylacetate (aliesterases) and naphthyllaurate (lipase). Results were expressed in the percentage of substrate metabolized. In the case of naphthylacetate, the enzymatic activity was greatly decreased: 45.5, 40.7, 31.9, 31.3, and 26.5% in 30 min; and 69.1, 58.7, 44.1, 47.4, and 41 in 60 min with the uranyl nitrate in $1/2000$ concentration. At $1/4000$ the results were: 27.8, 21.3, 17.4, 16.3, and 13.0 in 30 min; and 40.2, 35.5, 27.2, 28.5, and 21.8 in 60 min. In the case of naphthyllaurate, there was an immediate decrease in activity, followed by a return to normal and another decrease. With a uranyl nitrate concentration of $1/200$ the results were: 35.4, 26.8, 34.8, 34.8, and 32.5 in 30 min; and 59.1, 49.1, 59.0, 60.1, and 51.4 in 60 min. With a concentration of $1/400$ the results were: 25.5, 20.6, 24.5, 25.3, and 23.4 in 30 min; and 45.2, 37.2, 45.5, 46.6, and 40.7 in 60 min. Esterase activity in the cells of the convoluted tubules decreased under the influence of uranyl nitrate, with the exception of the tubules in which the lining had undergone alteration. (BBB)

33770 THE ACTION OF 5-NUCLEOTIDASE (SPECIFIC AMPase) IN MOUSE LIVER AND KIDNEY IN THE COURSE OF EXPERIMENTAL INTOXICATION WITH CARBON TETRACHLORIDE OR URANYL NITRATE (BIOCHEMICAL AND HISTOCHEMICAL STUDY). Alibert, Anny; Rigal, Marie-Therese; Malet, Paul; Bastide, Pierre; Turchini, Jean-Pascal; Distugue, Gaston (Faculte Mixte de Medecine et de Pharmacie, Clermont-Ferrand, France). J. Physiol. (Paris), 56: 526-7(July-Aug. 1964). (In French)

The activity of adenosine monophosphatase (AMPase) was measured in mouse liver and kidney after intraperitoneal injection with 0.2 ml/20 g in a 5% solution of CCl_4. Results are expressed in the percent of substrate metabolized in 30- or 60-min incubation periods at zero, 24, 48, 72, and 96 hr after poisoning with CCl_4. Hepatic AMPase increased, then decreased: at $1/25$ dilution of homogenate: 25, 27, 33, 17, 24.5% in 30-min incubation; 35, 38, 42, 29, 46% in 60-min incubation; at $1/50$ dilutions: 14, 18, 20, 10, 14.5% in 30 min; and 20, 26, 25.5, 16.5, 23.5% in 60 min. Renal AMPase activity remained stable after CCl_4: at $1/100$ dilution: 22.4, 27, 22.3, 23, 23.5% in 30 min; 39, 39.3, 34.2, 37.1, 41.1% in 60 min; at $1/200$: 11.9, 13, 10.5, 13.3, 12.1% in 30 min; 19.1, 19.5, 18.3, 20.8, 20.3% in 60 min. Renal AMPase activity decreased after intoxication with uranyl nitrate (intraperitoneal injection of 1 ml of 0.4% solution per 20 g): at $1/100$: 31.9, 30.1, 23.2, 28, 22.9% in 30 min; 57.3, 49, 41, 48.5, 40.5% in 60 min; at $1/200$: 18.2, 15.8, 10.2, 17.8, 12.2% in 30 min; 36.3, 29, 24.9, 28.5, 23.5% in 60 min. The histoenzymatic localization of hepatic AMPase activity was apparent in the sinusoids, biliary ducts, and the intrahepatocytic pericanalicular granules. Renal AMPase activity appeared on the glomerulus in the cortical zone, in the borders of the convoluted tubules, blood vessels, and intertubular tissue. After uranyl nitrate poisoning, renal AMPase activity appeared in the medullary zone (Henle loops). (BBB)

33771 THE EFFECT OF ADRENALECTOMY ON THE SUBMAXILLARY AND GASTRIC IODIDE PUMP. Llach, J. L.; Tramezzani, J. H. (Instituto de Biologia y Medicina Experimental, Buenos Aires). J. Physiol. (London), 174: 316-22(Nov. 1964).

The mice used were of the C_3H, A_2G, CFW, Balb, and DBA strains; their ages ranged between 70 and 90 days. They were injected subcutaneously with 5 μC of ^{131}I dissolved in 0.2 ml of normal saline. To avoid the effect of anesthetics on the concentration of I by the submaxillary glands the animals were killed by decapitation 90 min after the injection of ^{131}I. The concentration of ^{131}I by the submaxillary gland and stomach of normal, adrenalectomized, and castrated-adrenalectomized mice belonging to these strains was studied. The power to concentrate ^{131}I by the submaxillary gland and the stomach of mice varies with the strain of animals, the A_2G strain showing the highest ability of the six strains tested. The sex difference in the power to concentrate ^{131}I that has been described in the submaxillary gland does not exist in the stomach. Adrenalectomy increases the power of the submaxillary gland to concentrate ^{131}I but has no effect on that of the stomach. Castrated-adrenalectomized mice showed an even greater power to concentrate ^{131}I by the submaxillary gland than animals that underwent castration or adrenalectomy as single operations. It is suggested that a diminution in the salivary flow may be one of the factors that increases the submaxillary concentration of ^{131}I observed in adrenalectomized animals. The granular tubules of the submaxillary glands, the superficial epithelium, and the epithelium of the gastric pits of the fundus and pyloric portions of the stomach are the structures where radioiodine is concentrated. (BBB)

33772 THE CALCIUM CONTENT AND ^{45}CALCIUM UPTAKE OF THE SMOOTH MUSCLE OF THE GUINEA-PIG TAENIA COLI. Bauer, H.; Goodford, P. J.; Heuter, J. (Universitat, Mainz). J. Physiol. (London), 176: 163-79(Jan. 1965).

The total Ca content (in m mole Ca/kg wet wt) of the smooth muscle of guinea pigs measured by complexometric titration was 1.8 in muscles dissected from animals anesthetized with ether. It rose to 2.1 immediately after killing and bleeding the animal, and to 5.2 after preparation of the tissue at room temperature. After equilibration at 35°C in phosphate-free Krebs's solution containing 2.5 mM Ca, the Ca content of the tissue fell to 2.8 and remained constant for 5 hr. High concentrations were observed in anoxic (6.2), cold (4.0), or crushed (5.3) muscles, and after 24 hr in vitro (5.3). Uptake of ^{45}Ca shows three components: (1) A very rapid phase ($T_{\frac{1}{2}}$ < 30 sec) corresponding to an extracellular Ca space of 480 ml/kg wet wt at 35°C, which shrunk on cooling. (2) A phase with $T_{\frac{1}{2}}$ = 2-5 min containing about the same amount of Ca under all experimental conditions. (3) Slowly exchanging Ca which accounted for 5% of the tissue calcium at 35°C and 50% at 4°C. High tension was not necessarily associated with a high tissue-Ca content, but the production of tension coincided with an increase of tissue Ca. These observations are compatible with the hypothesis that membrane excitation and muscular contraction are linked by the movement of Ca towards the contractile mechanism, possibly down an inwardly directed electrochemical gradient. It appears that the Ca which enters under normal conditions of spontaneous activity can be extruded rapidly enough to maintain a steady state, since changes of muscle tension within the physiological range only produce a small change in Ca content. On the other hand, Ca which enters during a powerful contraction in abnormal conditions is not extruded rapidly enough, and may then accumulate in the tissue in an apparently inexchangeable form. (BBB)

33773 THE LOSS OF RADIOACTIVE ^{45}CALCIUM FROM THE SMOOTH MUSCLE OF THE GUINEA-PIG TAENIA COLI. Goodford, P. J. (Oxford Univ.). J. Physiol. (London), 176: 180-90(Jan. 1965).

The smooth muscle of the guinea pig was loaded with tracer ^{45}Ca in Krebs's solution in vitro, and the loss of ^{45}Ca into inactive Krebs's solution was measured for periods of up to 6 hr. At no time did the loss follow a single exponential course, suggesting either that the exchange was heterogeneous or that the rate was declining as the tissue aged during the course of an experiment. No changes in the rate of ^{45}Ca loss were observed in the absence of Na, in oxygen-free glucose-free solution or in the presence of 2,4-dinitrophenol 2×10^{-4}M at 35°C. In some experiments there was a slight transient slowing in high K solution. At 4°C the rate of loss was slowed, with a Q_{10} of 1.5 between 4 and 35°C. It is suggested that the rate of loss of Ca from the taenia coli in vitro may

be largely controlled by a physical process, unaffected by changes in the composition of the solution bathing the muscle. This does not exclude the possibility of a Ca-extrusion mechanism analogous to the Na pump, but it implies that such a Ca pump is not the rate-limiting stage in Ca extrusion. For this reason it cannot be detected when the muscle is poisoned with dinitrophenol. The observations suggest that there is a faster inflow of Ca in the Na-free, high-K, and oxygen-free glucose-free solutions while the taenia contracts. The over-all loss of Ca from the muscle is limited by the postulated physical process and the total muscle Ca therefore increases. When the taenia eventually relaxes its total Ca content remains high, but the extra Ca is relatively inexchangeable. This extra Ca may not be associated with the contractile mechanism, and is stored in the tissue until it leaks back into the intracellular pool by the slower rate-limited process. (BBB)

33774 ON THE INFLUENCE OF FAT-SOLUBLE VITAMINS ON THE METABOLISM OF ^{90}Sr AND CALCIUM IN THE GROWING RAT. PART 2. THE INFLUENCE OF VITAMIN A. Schmidt, B.; Lang, K. (Physiologisch-Chemisches Institut der Johannes Gutenberg-Universitaet, Mainz). Klin. Wochschr., 43: 375-82(Apr. 1, 1965).

In view of the action of vitamin A on mucopolysaccharide metabolism, which appears to control the deposition of Ca (and Sr) in skeletal tissues, the possible effect of the vitamin on ^{90}Sr and Ca uptake and retention by bone was studied. Young (60-g), female Sprague-Dawley rats were fed a standard diet containing ^{90}Sr (as $SrCl_2$) at a level of 1950 pC/g Ca. Vitamin A was added to the diet at levels of 100, 1000, or 10,000 IU/rat/day. Growth acceleration was seen with the lower range (100 and 1000 IU) and growth inhibition with 10,000 IU of vitamin A. The absorption of ^{90}Sr and Ca was slightly increased with doses of 100 and 1000 IU. With 10,000 IU the absorption of ^{90}Sr ceased and the absorption of Ca was highly reduced. Growth and calcification of the skeleton was disturbed by an overdosage of vitamin A. The relation of anorganic : organic substances, however, was unchanged. With overdosage of vitamin A the retention of ^{90}Sr and Ca was decreased as compared with the food content. The excretion of ^{90}Sr and Ca in the urine decreased with increasing vitamin A doses as a result of the decreased absorption from the intestine. Under these conditions the blood level of ^{90}Sr was lowered, whereas the Ca level remained constant. Discrimation against Sr absorption was nonspecifically improved by low vitamin A doses. High doses were without influence on the discrimination because the absorption of Sr and Ca was blocked. The discrimination by the kidneys was highly improved over the whole range of vitamin A doses used. It is concluded that the discrimination by the skeleton with regard to the food content of Ca and ^{90}Sr is slightly improved by vitamin A. The influence of tissue injury caused by hypervitaminosis A on Sr and Ca metabolism is discussed. (BBB)

33775 IODINE EFFECTS ON THYROID FUNCTION IN SPORADIC GOITROUS CRETINISM. Zondek, Hermann; Leszynsky, Hannah E. (Bicur Cholim Hospital, Jerusalem). Nature, 206: 1258-9(June 19, 1965).

Studies were made to determine whether in the conditions of "stosstherapy" thyroid hormone acted as a whole, or whether it merely served as a vehicle for iodine. Inorganic iodine in equivalent amounts to those present in the thyroid stoss (a total of 65.5 mg in the form of potassium iodide) was given within 9 days to two cretins during a relapse. It was found that the triggering effect of stosstherapy is not bound to the end-product of thyroid secretion, thyroid hormone(s), but may also be obtained with its starting material, iodine. When iodine was given during a remission, a transient but profound depression of all parameters of thyroid function without any changes in the clinical condition was noted. The bi-phasic action of iodine emerging from the studies appears to be causally related to the functional state of the gland. (P.C.H.)

33776 ADENOSINE TRIPHOSPHATASE ACTIVITY IN TWO STRAINS OF STAPHYLOCOCCUS AUREUS DIFFERING IN RADIOSENSITIVITY. Giovannozzi-Sermanni, G.; Tomati, U.; (CNR, Rome and Univ. of Rome). Nature, 206: 1271-2(June 19, 1965).

Adenosine triphosphatase (ATPase) was used as an index of the variations in ATP in two strains of Staphylococcus aureus with different radiosensitivity. The results showed that ATPase is increased by irradiation in the normal strain. The different behavior of the resistant strain toward irradiation is shown by the fact that the ATPase remains unchanged. Cystamine depressed the ATPase of the normal strain when compared with the irradiated sample, but the level still remained higher than that of the control; meanwhile, the depression, in the resistant strain, was more evident and reached values considerably lower than the control. (P.C.H.)

33777 DISPERSION OF THO AND ^{36}Cl UPTAKE BY SUNFLOWER ROOT SYSTEMS. Raney, Franklin; Vaadia, Yoash (Inst. of Arid Zone Research, Beersheva, Israel). Physiol. Plantarum, 18: 8-14(1965).

In a study of the effect of environmental factors on rate of water movement in herbaceous plants, the diffusion of tritiated water and $K^{36}Cl$ was measured from labeled nutrient solutions into the tissue of an excised entire root system as well as from the external solution through a detopped root system and out of the stump as an exudate. Seedlings of Helianthus annuus, variety Advance, were used in both experiments. The roots were placed in a solution containing tritiated water with a specific activity of 0.1 μC/ml, and at various elapsed times the root systems were removed and frozen. Other plants were topped and placed in half Hoagland solution containing 0.1 μC/ml THO or 0.01 μC/ml of ^{36}Cl, and at various times the total volume of exudate was determined. Half-time to THO equilibrium in detached root systems was 0.5 min. However, the appearance of tritium in the exudate required several hours depending on rate of exudation. With very slow exudation rates, where diffusion is relatively more prominent, several days may elapse before the exudate comes to equilibrium with external solution. The rate of ^{36}Cl appearance in the exudate depends greatly on the salt status of the plant. In high-salt plants the rate of ^{36}Cl movement approximates that of THO but in low-salt plants ^{36}Cl movement is very rapid, with the exudate concentrations exceeding the external concentration by several fold. This indicates that in low-salt plants salt transfer into the xylem is linked to metabolism and salt accumulation. The much longer half-time observed for the appearance of tritium in the exudate as compared to its half-time of diffusion into the root system itself implied that: (1) THO enters the xylem in younger portions of the root; (2) equilibration of concentrations in the xylem along its longitudinal axis is slow when exudation rates are low; (3) the time required for longitudinal equilibration in the xylem during exudation precludes that the osmotic pressure of sampled exudate will estimate correctly the osmotic pressure of the xylem sap at point of entry into the xylem. (BBB)

33778 IRON-55 IN HUMANS AND THEIR FOODS. Palmer, Harvey E.; Beasley, Thomas M. (Battelle-Northwest, Richland, Wash.). Science, 149: 431-2 (July 23, 1965).

Measurable quantities of iron-55 are present in people, animals, and food. The amount in Eskimos and caribou at Anaktuvuk, Alaska, is about eight times that in residents and cattle near Richland, Washington. Meat and grains are the foods that contribute most to the body burdens of iron-55 in human beings. (auth)

33779 SERUM PROTEIN AND BLOOD PICTURE CHANGES IN RATS AFTER INTRAVENEOUS INJECTIONS OF ^{32}P, ^{89}Sr, AND ^{198}Au. Peters, Karl; Bauer, Robert (Universitaet, Tuebingen, Ger.). Strahlentherapie, 127: 253-67(June 1965). (In German)

Irritating reactions can partly superimpose or cancel characteristic radiation effects in serum protein and blood pictures. A comparison of the three experimental series indicates that the results obtained depend upon type of dose and dose rate, biological half life time, and on the method used. (auth)

33780 THE ACUTE TOXICITY OF DRUGS AFTER WHOLE-BODY IRRADIATION. Frik, Wolfgang; Strubelt, Otfried; Wittmann, Klaus (Universitaet, Erlangen, Ger.). Strahlentherapie, 127: 345-52(June 1965). (In German)

Comparative studies on the toxicity of 64 drugs were made by determining the LD-50 in non-irradiated mice and in mice which had received 500 R total-body irradiation 4 days prior to drug administration. Sixteen drugs showed an increased toxicity and 14 drugs showed a decreased toxicity in the irradiated animals; the toxicity of the remaining substances was the same in irradiated and non-irradiated animals. Drugs which showed an increased toxicity in the irradiated animals, have a paralyzing or exciting effect upon the central nervous system when used in toxic doses. Among the drugs, which exhibited decreased toxicity after irradiation, are many substances, which affect the circulatory system when used in toxic doses. The majority of the drugs which are important in the treatment of radiation injury in humans produced no toxicity increase after irradiation. (auth)

33781 EXPERIENCE WITH THE USE OF RADIOACTIVE HYDROGEN IN INDUSTRY. Groot-Wesseldijk, A. Th. (Philips' Gloeilampenfabrieken, N. V., Eindhoven, Netherlands). Tijdschr. Sociale Geneesk., 42: 854-7 (1964).

When it was necessary to use a radioactive substance in the mass production of a certain type of radio tubes the hydrogen isotope tritium (^3H) was chosen. Preference was given to tritium as a gas and not in a chemical combination. In case the gas is accidentally inhaled it is not deposited in an organ or tissue; instead the tritium is dissolved in the body fluids and rapidly excreted by the kidneys. Occasionally small amounts of tritium were found in the urine of men working with the isotope. (Excerpta Med.)

33782 THE BINDING OF METAL IONS BY TURNIP YELLOW MOSAIC VIRUS. Johnson, M. W. (Agricultural Research Council, Cambridge, Eng.). Virology, 24: 26-35 (Sept. 1964).

Turnip yellow mosaic virus (TYMV) prepared by several different procedures was analyzed for metal ions. Precipitation of the virus near its isoelectric pH in the presence of tetraethylammonium ethylenediamine tetraacetate (TEA-EDTA) removed most of the metal ions from the virus. This metal-ion-deficient TYMV was found capable of loosely binding large amounts of Li^+, Na^+, K^+, Mg^{2+}, Sr^{2+}, and UO_2^{2+}. Nearly all the monovalent ions and much of the divalent ions so bound could be removed by dialysing against water or salt solutions. Smaller amounts of Mg^{2+} and Sr^{2+} remained firmly bound to the virus and Sr was shown to be associated principally with ribonucleic acid. The affinity of metal ion-free TYMV for added Sr was measured by using ^{85}Sr. A labeled solution was prepared by adding 1 mC $^{85}SrCl_2$ (In HCl) to 60 ml of a 6% solution (w/v) of $^{nat}SrCl_2 \cdot 6H_2O$, so that 1 ml of the solution contained 20 mg ^{85}Sr and about 17 μC ^{85}Sr. For Sr a similar binding pattern to that for Mg was found, but the total number of ions bound at all levels was much lower. The number of ions per particle carried out of solution was only about 1.9×10^3, and only about 0.45×10^3 remained after dialysis against 0.1M TEA-EDTA. The actual weight of Sr bound was very similar to the weight of Mg, which is probably reflected in the very similar increases in sedimentation coefficients found for each ion. It was possible to obtain uranyl-TYMV complexes with sedimentation coefficients as high as 135 S, an increase of about 20%. The virus peak in the analytical ultracentrifuge was still quite sharp and there was little indication of heterogeneity. This large increase sedimentation coefficient of uranyl-TYMV is of considerable interest, particularly as this complex cation appears to bind to all TYMV particles at about the same rate, producing a quite homogeneous population of uranyl-virus particles. Assuming that the increase in weight of the particle accounts exactly for the increase in sedimentation coefficient, the max amount of uranyl bound is equivalent to about 5000 ions per particle. Attempts are being made to determine the distribution of the uranyl groups within the virus particle. These experiments indicate that TYMV can contain metal ions bound with a range of different stabilities. Some of these ions may readily be exchanged for others during preparative procedures. In addition to any metal ions which might constitute an integral part of the virus structure there will also be a population of ions, some of which might be quite firmly bound. The large number of negatively charged internucleotide phosphate and dicarboxylic acid carboxyl groups present in the virus explain its behavior toward cations. (BBB)

33783 STUDIES ON ANTITUMOR DRUGS. XVII. INFLUENCE OF Sb-71 ON INCORPORATION OF ^{65}Zn INTO TUMOR CELLS IN MICE BEARING EHRLICH ASCITES CARCINOMA. Chou, Chin-hsu; Ren, Fan-you; Shen, Mai-lin; Hsu, Bin (Inst. of Materia Medica, Academia Sinica, Shanghai). Yao Hsueh Hsueh Pao, 11: 322-8(May 1964). (In Chinese)

A study of the relation between the structure and activity of some Sb-complexones showed that the bound form of Sb-chelating compounds such as Sb-71 produced a more marked antitumor effect. These studies were based on the previous report that the growth of malignant tumors is closely associated with the metabolism of trace metals, and that this metabolism can be altered by metal chelates. Thus the action of Sb-71 and its analogs on incorporation of ^{65}Zn into tumor cells was investigated; $^{65}ZnCl_2$ was injected intraperitoneally to mice bearing Ehrlich ascites carcinoma and radioactivity was measured in the tumor cells. Total protein nitrogen of the tumors was determined by the modified micro-Kjeldahl method and Biuret methods in experiments performed both in vitro and in vivo. The in vitro experiments showed that Sb-71 and other compounds such as ethyleneaminetetraacetate (EDTA)-$HgNa^+$, EDTA-$BiNH_4^+$, EDTA-$PbNH_4^+$, EDTA-$SnNH_4^+$, and EDTA-$BaBa^{2+}$ produced definite inhibition on ^{65}Zn incorporation into tumor cells, varying from 22 to 60%. ATA and Sb-71 (antimony ammonia triacetic acid) exhibited more marked effects than EDTA complexes, while tartar emetic had none. In mice, a single intraperitoneal injection of 30/mg/kg of Sb-71 caused a marked depression on ^{65}Zn incorporation into tumor cells. The maximum action was attained 5 to 7 hr after injection; meanwhile, the radioactivity of nucleoprotein decreased significantly. Twelve hours later the inhibitory effect subsided. Under the influence of the drug, the combination of ^{65}Zn with liver protein was unchanged. It is suggested that the action of Sb-71 shows some selectivity for tumor cells. The intraperitoneal injection of ATA did not produce inhibition of Zn incorporation into tumor cells, but promoted the removal of ^{65}Zn from the ascitic fluid. In mice bearing Ehrlich ascites carcinoma, after intraperitoneal injection of EDTA-$HgNa^+$ (4 mg/kg), EDTA-$BiNH_4^+$ (10 mg/kg), or EDTA-$PbNH_4^+$ (200 mg/kg), all except EDTA-$HgNa^+$, failed to alter ^{65}Zn incorporation into tumor cells as compared with control groups. (BBB)

Radiation Effects

Refer also to abstracts 33745, 33995, 34040, 34075, and 34596.

33784 (ABCC-15-63) JNIH-ABCC LIFE SPAN STUDY [OF] HIROSHIMA AND NAGASAKI. REPORT 3. MORTALITY, OCTOBER 1950-SEPTEMBER 1960. Jablon, Seymor; Ishida, Morihiro; Yamasaki, Mitsuru (Atomic Bomb Casualty Commission, Hiroshima (Japan)). [June 11, 1963]. Contract AT(49-1)-Gen-72. 51p. Dep.(mn); $2.00 (cy), 1(mn) CFSTI.

Mortality data from 1950 to 1960 are present for a sample of nearly 100,000 persons located from 0 to 2499 m from the hypocenter of the atomic explosions at Hiroshima and Nagasaki in 1945. Data on sex, age, estimated radiation exposure, burns, and symptoms of acute radiation injury are included. During the 10-yr period, 8641 deaths were observed, or 8.7% of the sample. The most frequent cause of death was vascular lesions affecting the central nervous system. When the sample was compared with a control Japanese population, a possible effect of radiation exposure

on life span was demonstrated, a large excess of leukemia mortality, a rise in incidence of malignant neoplasms, and a rise in incidence of tuberculosis with an increase of mortality in every age group were found in the irradiated population. (C.H.)

33785 (AD-426004) REACTIVITY OF SULFHYDRYL GROUPS IN BOVINE PLASMA ALBUMIN BEFORE AND AFTER ULTRAVIOLET IRRADIATION. Interim Report, September–November 1963. Stricks, Walter (Marquette Univ., Milwaukee, Wis.). Contract DA-49-193-MD-2146. 30p. $3.60(CFSTI).

A study was made of the activity of sulfhydryl and disulfide groups in bovine plasma albumin after various periods of ultraviolet irradiation. The reactivity of these groups was studied by way of amperometric titrations using mercuric chloride, ethylmercuric chloride (EMC), and silver nitrate as titrating agents. Upon irradiation, disulfide groups of albumin are split and the titratable amount of sulfhydryl increases. Under the experimental conditions the maximum number of disulfide groups which can be broken by UV irradiation was found to be eleven, while the remaining six disulfide groups remain unattacked by irradiation. This was found for albumin solutions irradiated in the absence and presence of 4F guanidine hydrochloride. Apparently the radiation effect for albumin, as far as the disulfide bonds are concerned, is the same, no matter whether the protein is initially in the native or unfolded state. It can be concluded that the changes in the secondary structure of albumin are of similar nature in guanidine and radiation denatured protein. (auth)

33786 (NYO–2043-108, pp 33-43) RADIATION BOTANY. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The radiosensitivity of several plant species, including banana, sugar cane, and several bean (Phaseolus) species was determined using a ^{137}Cs γ source. Results indicated that each vegetatively propagated or perennial plant species has a maximum dose of chronic radiation at which the plants can survive for a lengthy period under continuous irradiation. Data are included on the mutation frequency and mutation spectrum induced by a semi-lethal dose of γ radiation in a variety of beans. Mutants were selected for high yield and plant vigor and used in a plant breeding program. (C.H.)

33787 (NYO–2043-108, pp 69-94) STERILIZATION OF THE MEDITERRANEAN FRUIT FLY AND ITS APPLICATION TO FLY ERADICATION. Katiyar, K. P.; Ferrer, F. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

Progress is reported from studies on the effects of the release of sterile males on the control of populations of Mediterranean fruit flies. The female of this species is polygamous. Males were made sterile by exposure of pupae to 10,000 R γ radiation. Results are presented from a study of the fertility of females that first mate with an irradiated male and then with a normal male, or vice versa. Results indicate that the influence of the second mating is always greater than the first one on egg fertility. The effects of humidity and diet on egg hatch and performance of fruit flies is discussed. (C.H.)

33788 (NYO–2043-108, pp 97-102) EVALUATION OF THE STERILE MALE TECHNIQUE FOR CONTROLLING THE COFFEE LEAF MINER, LEUCOPTERA COFFEELLA GUER. Katiyar, K. P.; Ferrer, F. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

The leaf miner, Leucoptera coffeella, is a serious pest in all coffee producing countries. The larvae feed on the parenchymatous tissue of the leaves and complete defoliation of coffee plants is not uncommon. The life cycle of this insect is described and the suitability of using the γ radiation induced sterile male technique to control this pest is discussed. (C.H.)

33789 (NYO–3445-3) ATTEMPTS TO DEMONSTRATE THE LYSOSOMAL NATURE OF EPIDERMAL DNases I AND II AND ACID AND ALKALINE PHOSPHATASES. First Year Progress Report, August 14, 1964–April 15, 1965. (Albert Einstein Medical Center, Philadelphia, Pa. Lab. of Experimental Dermatology). Contract AT(30-1)-3445. 29p. Dep.(mn); $2.00(cy), 1(mn) CFSTI

Results are reported from a series of studies on the effects of doses of 600 to 3000 rep β irradiation on enzyme activity in the epidermis of guinea pigs at various time intervals after exposure. Data are presented on the activity of desoxyribonuclease and acid and alkaline phosphatases in extracellular and intracellular components of the epidermis. Reaction mechanisms involved are discussed. Results are included from a study of the effects of slight to severe trauma on desoxyribonuclease activity in epidermis that indicate that an increase in extracellular desoxyribonuclease observed after skin trauma is associated with epidermal cell proliferation rather than cell death. (C.H.)

33790 THE CONCENTRATION OF NONESTERIFIED FATTY ACIDS IN MATERNAL AND FETAL PLASMA IN NORMAL, ALLOXAN-DIABETIC, AND X-IRRADIATED RATS. Haude, W. (Friedrich-Schiller Universitat, Jena, Ger.). Acta Biol. Med. Ger., 13: 725-33(1964). (In German)

Plasma nonesterified fatty acid (NEFA) levels were determined in pregnant rats and their fetuses. In some rats, diabetes was induced by subcutaneous injection of 140 mg/kg alloxan two days before the experiments and other pregnant rats received a single whole-body 400-R dose of x rays (200-kv, 40 R/min). A sham-irradiated control group was also used. In normal pregnant rats studied on the 20th to 22nd day of gestation, plasma NEFA levels were similar to those of nonpregnant rats. However, fetal plasma NEFA levels were about ½ that of maternal animals (0.20 meq/l vs 0.40, on the 21st day of gestation). Alloxan diabetes produced a five-fold rise in maternal NEFA in plasma (to 2.02 meq/l) but only a slight rise in the fetal concentration (to 0.27 meq/l), which was not significant. Irradiation of the pregnant rats on the 17th day of gestation did not affect appreciably the values of NEFA either in the maternal or fetal plasma. The sham-irradiated and x-irradiated animals showed similar nonsignificant fluctuations. This shows that irradiation, unlike alloxan-induced diabetes, does not cause rapid mobilization of fatty acids from fat tissue. These findings in irradiated fetuses are in contrast to earlier electron microscopic studies in which it was found that fetal liver fat deposits are increased after irradiation, presumably by mobilization of fatty acids from the maternal organism. (BBB)

33791 SKIN ABSORPTION OF THE BETA RAYS EMITTED BY A $^{90}Sr/^{90}Y$ SOURCE. Patetta Queirolo, M. A. (Universidad de Carabobo, Valencia, Venezuela). Acta Cient. Venezolana, 15: 26-8(1964).

A study was made of the absorption of beta rays from $^{90}Sr/^{90}Y$ by the skin of the toad (Bufo marinus L.). The range of beta particles, the apparent mass absorption coefficient, and the effect of absorber position were measured using aluminium and skin as absorbers between detector and beta-ray source. (Excerpta Med.)

33792 ON THE PROTECTIVE EFFECT OF MERCAPTAMINE IN THE DISTURBANCE OF Na AND FLUID BALANCE IN THE GASTROINTESTINAL IRRADIATION SYNDROME. Zsebok, Zoltan; Petranyi, Gyozo Jr. (Medical Univ., Budapest). Acta Med. Acad. Sci. Hung., 20: 215-25 (1964). (In German)

Rats were given 1500 R of whole-body irradiation in a single dose at a rate of 45 R/min. The rats were treated 5 min before irradiation with mercaptamine, given at a dose of 150 mg/kg, and 30 min after the irradiation they were injected intravenously with 10 μC of ^{24}Na. The total exchangeable Na, its distribution, and its intestinal absorption were measured daily for 7 days postirradiation. The amounts of Na lost by treated and untreated animals within the first three days after irradiation were almost identical, being 1.8 and 1.6 meq/100 g. After this, in the treated animals the extracellular Na increased. The animals lost only 0.6 meq/100 g of their total exchangeable Na within three

days. The serum Na concentrations also increased. These changes were associated with a decrease in total bone Na, and an increase in exchangeable bone Na, which suggested mobilization of the stable bone Na. Mercaptamine treatment also decreased the characteristic reduction of insulin space usually observed with the gastrointestinal irradiation syndrome. In the treated animals Na concentrations in the intestinal mucosa increased four-fold. Resorption of Na was markedly decreased in the untreated animals. Thus, when an irradiation dose 2.5 times the lethal dose was given, mercaptamine did not prevent reduction of Na resorption, but the capacity to recover and normalize Na resorption was greater in the surviving, treated animals. (BBB)

33793 THE VIRUS IN LEUKEMIA OF THE MOUSE (GROSS). Gross, L. (Veterans Administration Hospital, Bronx, N. Y.). Acta Oncol., 2: 37-42(Jan.-June 1963). (In Spanish)

A review, including the role of x radiation, in the viral induction of leukemia in mice. (BBB)

33794 AGING, ANOMALIES, AND RADIATION EFFECT OF THE RABBIT LENS. Geeraets, Walter J.; Harrel, Wade; Guerry III, DuPont; Ham, William T. Jr.; Mueller, Harold A. (Medical Coll. of Virginia, Richmond) Acta Ophthalmol., 43: 3-21(1965).

The effects of radiation on the lens was studied in six- to eight-week-old Dutch rabbits. A 16-mm dia beam of 1-Mev x rays was used for whole-lens irradiation at seven dose levels ranging from 25 to 1000 R. Slit-lamp examinations of the lenses were carried out, at intervals, up to one yr later. Significant lens changes occurred in rabbits with a dose as low as 25 R, if radiation was delivered to the whole lens. This observation was supported by in vitro experiments utilizing microagar electrophoresis. Lenses exposed to 25 R and studied by this method one year after irradiation showed electrophoretic boundaries deviating from those of normal control eyes. There was a definite relation between irradiation dose and severity of final lens changes. The onset of visible changes caused by irradiation occurred in all cases after a latent period. For individual lenses, the latent period did not necessarily depend on the irradiation dose. The shortest latent periods for individual lenses in the low-dose groups corresponded closely to the shortest latent periods in the high dose groups. However, the mean latent period for each dose group varied inversely with the dose employed: the higher the dose, the shorter the latent period. Progression of lens changes were more rapid at the higher dose levels. Changes caused by age occur as early as five-and-a-half months of age but with a range of onset up to 11 months of age until all animals show such changes. Lens changes caused by aging and those resulting from irradiation do not appear to be related. Partial irradiation of the germinative layer of lenses by a 3-mm x-ray beam produced characteristic changes located in the posterior cortex of the lens, at doses of 600 or 1000 R. Radiation cataract may manifest itself in various patterns, depending on the type of irradiation employed. Triangular-shaped cataracts with the base of the opacity at the posterior suture line resulted from localized irradiation to the germinative layers of the lens. Posterior opacities of various densities and extent resulted from whole lens irradiation, the severity of the cataracts being dependent on the radiation dose employed. The dose for the production of lens changes with partial lens irradiation was considerably higher than for whole lens irradiation; while the latter occurred with an x-ray dose of 25 R, the former did not develop with 200 R. The x-ray threshold dose for partial irradiation lens changes (3-mm x-ray beam), thus, must be between 200 and 600 R. (BBB)

33795 PATHOLOGICAL STUDIES OF EXPERIMENTAL BONE TUMOR. Horie, Kenya (Tachikawa Hospital, Tokyo). Acta Pathol. Japon., 14: 75-83(Jan. 1964).

The use of ^{32}P in the induction of bone tumors in Wistar rats is reported. The femurs, tibias, and vertebras of rats injected intraperitoneally once monthly with ^{32}P in doses of 1 mC/kg of body weight were examined. Initial pathological changes were found in the epiphyseal plate and the metaphysis two months after ^{32}P administration, and the first osteogenic sarcoma was found after eight months. It is considered that this early lesion of epiphyseal plate and metaphysis is a preparatory change to osteogenic sarcoma. One injection of chemical cancerogenic agents, such as methylcholanthrene and benzyprene, was given, combined with ^{32}P, three months after an initial injection of ^{32}P. This combined use of ^{32}P and chemical agents resulted in a rise of the cancerogenic rate (48% vs 27% with ^{32}P alone). The primary lesion of experimental osteogenic sarcoma developed in the metaphysis. The process of formation of this osteogenic sarcoma from the initial to the final stage was investigated, as well as the course of differentiation of the osteogenic sarcoma from immature to mature sarcoma. Successive transplantations of the osteogenic sarcoma were performed subcutaneously, and sometimes intramedullarily and intraperitoneally. One series of the subcutaneous transplantations has now continued for 20 successive generations during four years and three months and is still being continued. During successive subcutaneous transplantations the sarcoma lost its osteoplastic ability. However, an osteoplastic sarcoma developed again, when the nonosteoplastic sarcoma, which had lost its osteoplastic ability during successive subcutaneous transplantations, was retransplanted intramedullarily. (BBB)

33796 EFFECTS OF CONTINUOUS IRRADIATION DURING GESTATION AND SUCKLING PERIODS IN MICE. Roennbaeck, C. (Research Inst. of National Defence, Sundbyberg, Sweden). Acta Radiol. Therapy, Phys., Biol., 3: 169-76(June 1965).

CBA mice were irradiated with ^{131}Cs γ-rays at a low rate during the fetal stage and the suckling period. Females that received 170 R during the suckling period were sterile, but those irradiated as fetuses were not. Irradiated males exhibited no decrease in fertility. (auth)

33797 ETIOLOGY OF CONGENITAL MALFORMATIONS. Robert, J. M. (Centre de Genetique, Lyon). Actualites Pharm., No. 35, 507-14(Nov. 1964). (In French)

The effects of ionizing radiations and drugs in causing deformities in utero are reviewed. (BBB)

33798 MECHANISMS OF RESISTANCE TO ANTICANCER AGENTS. Brockman, R. W. (Southern Research Inst., Birmingham, Ala.). Advan. Cancer Res., 7: 129-234(1963).

The resistance of cells to antimitotic agents, such as purine and pyrimidine analogs, glutamine antagonists, folic acid analogs, steroids, alkylating agents, and ionizing radiation is reviewed. It has been widely accepted that x radiation and alkylating agents have many biological effects in common; because of this the term radiomimetic is applied to alkylating agents. Ionizing radiation was shown to rupture the imidazole ring of the guanine moiety of DNA in vitro, and the hypothesis was advanced that the alkylation of the guanine moiety of nucleic acids might in effect produce a purine analog. In the case of difunctional alkylating agents such an analog might be reactive by virtue of the single alkylating function remaining. Another possibility is that breakdown of the imidazole ring of purines, guanine in particular, might be as effective in disrupting subsequent nucleic acid synthesis and function as would replacement of bases by analogs or deamination of nucleic acid bases by nitrous acid. In view of some of the similarities in the biological effects of x radiation and alkylating agents it is of interest that neoplasms resistant to nitrogen mustards are not cross-resistant to x radiation. Cyclophosphamide-resistant and TEM-resistant sublines of a hamster plasmacytoma were isolated and found to be cross-resistant to other alkylating agents and to mitomycin C but not to x radiation. Thus, despite similar biological effects, x rays and alkylating agents differ in their mode of action against these neoplasms. In contrast to these findings, Escherichia coli resistant to alkylating agents were also resistant to uv light, which points up differences between microbial

and mammalian systems or between x radiation and uv radiation effects. Examples of mitomycin C-resistant E. coli were also obtained that were cross-resistant to uv radiation and similar observations were made in other microorganisms. Mitomycin C has been termed a radiomimetic agent. Alkylating agents, x radiation, and mitomycin C do appear to have in common the capacity to bring about degradation of nucleic acids. However, alkylating agents may do this by 7-alkylation, followed by scission of the imidazole ring of purines; mitomycin C may activate DNase; ionizing radiation may break DNA chains. Thus, there appears to be no common mechanism by which these different agents bring about nucleic acid degradation, and observations on cross-resistance must be interpreted with caution until more is known of mechanisms by which cells may become resistant to these interesting cytotoxic agents. (BBB)

33799 MALE STERILIZATION FOR THE CONTROL OF INSECTS. Bushland, R. C. (Dept. of Agriculture, Kerrville, Tex.). Advan. Pest Control Res., 3: 1-25 (1960).

The use of ionizing radiation and other agents in the sterilization of male insects for pest eradication programs is reviewed, after an extensive discussion of the effect of radiations on insects. When well-developed pupae or adults are given a heavy dose of radiation (usually 5000 to 10,000 R), so many mutations are produced in every germ cell that, merely through operation of the law of averages, each nucleus contains at least one dominant lethal mutation. When a male insect that was treated as a young adult or pupa with a sterilizing dose of radiation mates with a normal female, irradiated sperm are deposited in the vagina of the female. When the female oviposits, each egg is penetrated by a sperm and the egg becomes fertilized. The chromosomes contributed by the sperm have been so changed that the heredity of the zygote is inadequate for even one complete cell division. The sterilizing dose is so adjusted that the male parent receives just enough radiation to prevent hatching of any fertilized egg. Therefore, it is a misnomer to call irradiated males sterilized, since they do produce motile sperm which fertilize eggs. However, since the embryos die without hatching, it is convenient to speak of the males as sterile and the eggs infertile. The irradiation technique seems applicable only to adults or to pupae in which the vital adult organs are already formed. If doses of radiation are given to immature stages the effects are not sterilizing but lethal. In immature insects, mitosis is proceeding in the differentiation and growth of somatic tissues. These somatic cells when they are dividing rapidly are just as subject to radiation as are germ cells during their rapid division. Therefore, a sterilizing dose of radiation that is tolerated by somatic tissue in the adult is lethal to that tissue in an earlier stage. The radiosterilization of screwworm flies (Callitroga hominivorax) in attempts to eradicate them are reviewed. Screwworms were sterilized by irradiating pupae that had been incubated at a constant temperature of 80°F for 5 days. Males were sterilized by a dose of 2500 R and females by 5000 R. Females treated with this dose could not oviposit. A dose of 7500 R or more prevented egg production, and males or females seemed to tolerate doses as high as 20,000 R as well as they did the minimum female sterilizing dose of 5000 R. When normal females were caged first with irradiated males for mating and then with normal males, they did not mate again but deposited only infertile egg masses. The mating habits of the females of the species to be controlled are commented on. The screwworm program was made simple because of absence of multiple matings. However, the fact that females of many species mate repeatedly need not obviate the application of the sterilization technique for their control. If females mate repeatedly and the stored sperm are mixed in the spermatheca and compete equally, then the reduction in biotic potential of the species is just as significant as with single-mating species. The eradication of screwworms from the island of Curacao was accomplished by releasing irradiated screwworm flies continuously for six months. Experiments in mass production of radiosterilized screwworm flies are described, and the use of radiosterilized males for control of other insects examined. Females of the oriental fruit fly (Dacus dorsalis), the Mediterranean fruit fly (Ceratitis capitata), and the melon fly (Dacus cucurbitae) mate repeatedly, and when those flies mated first with normal males, subsequent matings with radiosterilized males did not reduce the fertility of eggs deposited after the second mating. To sterilize both sexes of the flies and prevent any egg laying, pupae had to be irradiated with 8400 to 10,000 R of γ rays. However, this high dose affected the vigor of the males so that the practical dosage appeared to be in the range of 6700 to 8400 R. This dose was not sufficient to cause permanent sterility in the irradiated males and after 30 to 50 days some of the irradiated males regained fertility. In spite of these difficulties in mating tests with normal and sterilized flies the resultant egg sterility was proportional to the ratio of irradiated and normal flies in the caged population. Thus, despite the unfavorable factors encountered, along with the problem of the larger populations to be suppressed than were encountered in the screwworm experiments, the method has promise of being a useful eradication tool against isolated fruit fly populations. For other species it is essential to know, not only at what age mating occurs and how frequently each sex copulates, but the details of spermatogenesis and oogenesis as they relate to establishing the time for a sterilizing dose of γ radiation. (BBB)

33800 METABOLISM AND X-RAY SENSITIVITY OF CHICK EMBRYOS INCUBATED IN A HELIUM–OXYGEN ATMOSPHERE. Wright, R. A.; Lessler, M. A.; Weiss, H. S.; Hiatt, E. P. (Ohio State Univ., Columbus). Aerospace Med., 36: 311-14(Apr. 1965).

The effect of an inert gas on radiosensitivity and metabolism of the chick embryo was studied by incubation of fertile eggs in flexible polyvinyl insulators, in either air or a 79% He-21% O_2 atmosphere. The metabolic activity of homogenates of eight-day embryos was studied by a modified Warburg technique. Some preparations were exposed to 85-kv x rays at a dose of either 1000 or 2000 R and their respiratory activity was compared to the activity of paired unirradiated controls. Increased metabolic rate was observed in embryos incubated in the He-O_2 atmosphere and subject to a minimal exposure to air. Embryos incubated in the same atmosphere but subsequently exposed to air showed a significant depression in oxidative metabolism. Homogenates from either the air or He-O_2 incubated eight-day embryos showed no change in respiratory activity after 1000-R exposure; however, there was a significant depression in metabolism in both groups after 2000-R x irradiation. According to earlier work the metabolic depression should have been more severe in the He-O_2-incubated embryo homogenate. The failure to demonstrate this may have been due to the fact that in these trials the embryos were exposed to air before irradiation. The depression of metabolism in the He-O_2-incubated embryo homogenates after air exposure may indicate that those embryos were particularly sensitive to the depressant effect of N_2 after being incubated in a N-deficient atmosphere. During the eight days of incubation a consistently higher weight loss was seen in eggs incubated in He-O_2 mixtures, but the number of live embryos was the same and there were no significant differences in embryo dry weights. (BBB)

33801 DISTRIBUTION OF TERRESTRIAL ALGAE WITHIN THE NEVADA TEST SITE. Shields, Lora Mangum; Drouet, Francis (New Mexico Highlands Univ., Las Vegas). Am. J. Botany, 49: 547-54(July 1962).

The incidence of terrestrial algal species in natural soil growths at the Nevada Test Site was considered in relation to the major shrub zones and to atomic target areas. Observations are based upon samples collected in three successive years (1957 to 1959) from control sites in the various shrub types, at 0.1-mile intervals within 1.0 mile from five tower ground zeros, and from the vicinity of the one perennial body of water, Cane Springs. Twelve terrestrial algal species, other than diatoms, were identified by microscopic examination of natural soil growths. Four soil species appeared in culture only. Fifteen taxa occurred only in the vicinity of the one aquatic habitat. Colloidal sheaths of

Microcoleus vaginatus, Schizothrix californica, and Schizothrix acutissima stabilize soil particles, forming a surface crust. Nostoc commune, Scytonema hofmannii, and Protosiphon cinnamomeus are commonly associated with lichens. Algal species cultured from the vicinity of nuclear detonation sites are reported. Seed plants showed a gradient of decreasing evidence of damage between 0.6 mile and the 1.0 mile interval at which vascular vegetation appeared relatively unaffected. The abundant stand of annuals the following spring between 0.3 and 0.6 mile, interpreted as evidence of seed survival in the soil, indicates that the surface crust within this radius tended to remain in position. Algae occurring as natural soil growths within 0.6 mile of ground zero the year following detonation appeared to represent survivors of nuclear effects. Algae developing only in culture may be wind-blown contaminants. For detonations at the five tower target areas during the 1957 nuclear test series at the Nevada Test Site, energy yields in roentgen equivalents for mammals one min after burst were approximated as ranging from 60,000 for the smallest to 700,000 for the largest shot at 0.25 mile from ground zero, 3000-30,000 at 0.5 mile, and 700-6000 at 0.75 mile. While algae within 0.5 mile may have been removed with the soil or subjected to thermal injury, none at this distance were exposed to significant radiation levels. Microcoleus vaginatus was one of three algal species isolated from Nevada Test Site soils following acute γ exposures of 1280 kR from ^{60}Co. M. vaginatus has also grown on sterile and in cultures of test-site soil following acute experimental ^{60}Co exposures amounting to 2560 kR. This species is the first alga to colonize construction sites and roadsides in this area. The extreme aridity of the growing seasons of 1959 to 1961 may account for failure of this and other species to become re-established on bladed control plots and at ground zeros within three yr following denuding. Failure to invade cannot be explained on the basis of radiation levels since the outer margin of the 100 mR/hr zone typically receded to within 0.5 mile of ground zero within 1 week. The effects of soil removal, denuding and the presence of debris from fission products are reflected temporarily within the 0.4-mile radius of ground zero by a slightly higher pH and electrical conductivity and a lower Kjeldahl nitrogen than in the surrounding 0.5–1.0 mile. (BBB)

33802 POST-RADIATION OSTEOPATHY. Salib, P. I. (Massachusetts General Hospital, Boston). Am. J. Orthopedics, 6: 122-5(1964).

In acute radiation of the body about 90 to 97% of the radioactive substance is eliminated in the stool and in the urine during the first week. The rest is ultimately stored in the skeleton in a scattered fashion, tending to concentrate in areas of bone activity. Microscopically, bone changes in radiation osteitis are those of necrosis. The blood vessels are often destroyed. In experimental animals radiation results in congenital malformations. Five post-irradiation complications discussed include the retardation of bone growth; necrosis of bone; osteomyelitis; stress fractures; and post-irradiation sarcoma. Sarcomas are more common after internal irradiation and involve chiefly the hip and the knee. The gross appearance is similar to that of other bone sarcomas. It is stated that the maximum permissible internal deposit is 0.1 microgram of retained radium, whereas the amount of external irradiation necessary to induce sarcomatous changes is usually 3,000 roentgen units or more. Some benign lesions undergo malignancy following exposure to irradiation. Patients in their fifties who have retained radium in their bodies for about 25 years have developed sarcoma in 145 of cases. Although amputation is the only treatment, death from pulmonary metastasis may occur 1.5 years after the onset of symptoms. The management of post-irradiation effects is discussed. A skeletal survey is recommended every one to three years. (Excerpta Med.)

33803 SOME EFFECTS OF GAMMA RADIATION ON THE POTATO TUBERWORM, GNORIMOSCHEMA OPERCULELLA (LEPIDOPTERA: GELECHIIDAE). Elbadry, Esam (Univ. of Ain Shams, Shubra, U.A.R.). Ann. Entomol. Soc. Am., 58: 206-9(Mar. 1965).

When exposed to γ rays from ^{60}Co at a dose rate of 190 krad/hr, eggs and newly hatched larvae survived doses up to 8 krad. Immature stages that developed from irradiated eggs showed retardation of development and reduction in size and weight, and the adult moths that emerged were malformed. Females were more sensitive to irradiation than were males, and all doses delivered to the eggs reduced the fecundity of the adults that developed from them. Doses of 24 to 96 krad given to mature larvae prevented pupation; lesser dosages caused retardation of pupal development; and adult malformation started with dosages of 6 krad. Again adult fecundity was severely affected. Reduction in fertility of the eggs produced was most evident with females irradiated as 8-day-old pupae, but reduction in egg deposition was shown by those irradiated earlier in the pupal stage. The tendency for adults to be malformed also was more pronounced when early pupal stages were irradiated. Exposure of adult moths to doses up to 96 krad did not affect their longevity, but fecundity of the females fell away almost completely, to an average of only two eggs each. The first evidence of appreciable reduction in the fertility of the eggs that were laid was found with adults that were exposed to at least 6 krad. No larvae hatched from any eggs laid by females that had received 24 krad or more. Insects which had received 96 krad were sluggish, and all their body movements were decreased. As previously found with other insects, susceptibility to radiation injury decreased as development proceeded from the egg to the adult stage. While this was observed in the potato tuberworm, it was most pronounced in the pupal stage of this insect. For example, 1-day-old pupae succumbed to 6 krad while normal adults emerged from pupae exposed to 8 times that dosage at the 8th day of the pupal stage. (BBB)

33804 SOME GAMMA RADIATION EFFECTS ON HOST-PARASITOID RELATIONSHIPS. Elbadry, Esam (Univ. of Ain Shams, Shubra, U.A.R.). Ann. Entomol. Soc. Am., 58: 209-12(Mar. 1965).

Attempts were made to determine whether or not the host, when it is altered by γ radiation, will in turn affect its parasitoids. Also tested was the idea that parasitoids may be used as sensitive indicators of pathological conditions induced in the host by γ radiation. Two approaches were used. The first dealt with indirect effects, i.e., the effects of previously irradiated hosts on the biology of the parasitoids; the second was concerned with effects of direct irradiation of the parasitoids when intimately associated with the host. The potato tuberworm, Gnorimoschema operculella, and three hymenopterous parasitoids were studied. For the study of indirect effects, groups of 3-day-old tuberworm eggs were treated, respectively with doses of 3, 6, and 9 kR, then exposed for 24 hr to parasitization. The encyrtid Copidosoma koehleri, when reared in previously irradiated potato tuberworm hosts, showed symptoms of nutritional deficiency which included lessened polyembryony, slower development, and higher mortality in the various stages of the life cycle. The host larvae, irradiated before hatching from the egg, were smaller than normal, weighed less, and stored much less of the suprastomodaeal fat tissue on which C. koehleri subsists during its polygerm stage. The larval period of the braconid Macrocentrus ancylivorus was lengthened in such hosts, and there was greatly increased mortality of the adults within their cocoons. However, previous irradiation of the host eggs had no effect on the development of the trichogrammatid egg parasite Trichogramma semifumatum. Doses of 0.5-2 krad applied directly to polygerms of C. koehleri in previously unirradiated hosts induced pathological conditions. Embryos grew abnormally large and many failed to complete their embryonic development, and the embryonic period generally was lengthened. Though irradiation damage was thus evident at a very early stage in C. koehleri, its expression in M. ancylivorus was generally delayed until the adult stage. The percentage of emergence of adults from cocoons was reduced by low dosages given to eggs or larvae, and when such dosages were given to second-stage larvae the females that survived to adulthood were

crippled, with short wings and curled ovipositors and antennae. (BBB)

33805 INFLUENCE OF THE THYMUS AND OF THE ORIGIN OF THE RESTORATIVE CELLS ON IMMUNOLOGICAL FUNCTIONS OF ISOGENIC RADIOCHIMERAS. Duplan, J. F. (Institut Pasteur, Paris). Ann. Inst. Pasteur, 108: 1-12(Jan. 1965). (In French)

A systematic study was made of the function of time after whole-body irradiation on the recovery of immunologic reactivity in irradiated thymectomized mice, treated with suspensions of hematopoietic cells (from spleen, bone marrow, or fetal liver). Male and female mice of the XVII strain were irradiated with an 850-R dose of x rays ($LD_{98/15}$). By means of the graft versus host technique using spleen cells of (XVII X C57BL) F_1 donors, the immunologic reactivity of spleen cells of normal or thymectomized isologous radiochimeras was determined. The 30-day-old recipient mice were thymectomized one month before irradiation. In nonthymectomized mice, the immune function to the grafts reappeared from the 35th day on, and persisted during the whole experimental period (105 days). The smaller the number of immunologically competent cells contained in the restorative suspension, the more rapid and the more complete the restoration of immunologic capacity. This implies the action of a regulator mechanism, probably originating in thymus, which restores homeostasis. In thymectomized mice subjected to the same treatment, the immunologic reactivity reappeared only when splenic cells were used as restoration cells. In the absence of thymus, bone marrow and fetal liver cells were unable to reach immunologic maturity. No late mortality was associated with secondary mice receiving fetal liver transplants. (BBB)

33806 THE PHILADELPHIA CHROMOSOME AND SOME OTHERS. Hungerford, David A. (Inst. for Cancer Research, Philadelphia). Ann. Internal Med., 61: 789-93 (Oct. 1964).

A minute chromosome, known as the Philadelphia (abbreviated Ph^1), is an abnormality characteristic of some of the hematopoietic cells of most patients with chronic granulocytic leukemia (CGL). The chromosome change is a highly specific one in which one normal small acrocentric autosome, number 21, has lost half of its longer arm. In a typical case of this disease, 40% of the total DNA of the normal small acrocentric is missing. Whether this occurs by deletion from the genome or by translocation to another and larger chromosome where its presence can not be detected is not known. CGL is the only human neoplastic condition in which there has been found a constant and characteristic chromosome change of any kind, although other types of chromosome change are commonly observed. This provides the first clear-cut evidence supporting the somatic mutation theory of cancer. The cause of changes resulting in the production of the Ph^1 are obscure. This being one of the types of damage known to be caused by radiation, a high incidence of CGL might be expected among such groups as the Japanese atomic bomb survivors and those exposed to high levels of diagnostic or therapeutic radiation. In the former group this is the case, although acute leukemia is increased to an even greater extent, and at least one patient with CGL and the Ph^1 has so far been described among atomic bomb survivors. X-ray therapy in ankylosing spondylitis is also associated with an increased incidence of CGL in which the Ph^1 is present, but in view of the lack of any history of radiation exposure in most cases of CGL, the role of other mutagenic agents, such as chemicals and viruses, must be investigated. Whatever the cause, the susceptible hematopoietic cell must be a relatively undifferentiated one. The presence of the chromosome marker in most marrow cells, including those containing hemoglobin, requires the affected cell to have been a progenitor of erythrocytes as well as granulocytes. It is present also in polyploid cells. Other aspects of cytogenetics are discussed, especially those involving the X chromosome. (BBB)

33807 SENSITIVITY TO HOMOGRAFTS OF NORMAL TISSUES AND CELLS. Billingham, R. E.; Silvers, Willys K. (Wistar Inst. of Anatomy and Biology, Philadelphia). Ann. Rev. Microbiol., 17: 531-64(1963).

Selected subjects in transplantation immunity are reviewed (with 314 references) with emphasis on genetic aspects, transplantation antigens, role of lymphocytes in homograft rejection, and immunologic tolerance. The effects of ionizing radiation and cytostatic drugs in modifying the homograft rejection reaction are also considered. Attempts to promote or enhance the exchange of cells between mother and fetus, by treatments that increase the permeability of the placental barrier, include sublethal x irradiation of the exteriorized gravid uterine horns in rats and treatment of pregnant rabbits with hyaluronidase or histamine. The repeated treatment of pregnant does with relatively high dosages of these agents, from the tenth day of gestation onward, produced a significant weakening of the response of more than 50% of the progeny to subsequent homografts of maternal skin. Of interest in the light of earlier work is the finding that some of the treated mothers displayed unresponsiveness towards grafts of their offspring's skin. In mice, attempts to use x rays to breach the placental barrier to chromium-labeled red cells, or to cell capable of inducing tolerance in the offspring, have failed. Sublethal x irradiation preceding a single massive inoculation of donor spleen cells facilitates the induction of unresponsiveness to subsequent donor strain homografts. The ability of A strain mice to reject CBA grafts can be specifically inhibited by prior exposure to 350 to 400 R, followed by injection with 700 to 1200 million CBA/A splenic cells administered intravenously and intraperitoneally. The principal function of irradiation here is probably to liberate sites for colonization by the inoculated cells, rather than to destroy the host's immunologically competent cells. The observation that splenectomy, prior to irradiation and inoculation of antigen, results in sensitization rather than unresponsiveness, is consistent with this idea. This method of overcoming the homograft reaction has much in common with the more familiar one which entails exposure to a lethal dosage of a irradiation, and resuscitation by injection of much lower dosages of homologous hemopoietic tissue cells; they probably do not depend upon fundamentally different principles. With some so-called difficult strain combinations, such as A → C57 in which strong H-2 differences are involved, induction of tolerance by inoculation of neonatal hosts is facilitated by prior sublethal x irradiation as in the case of adult subjects. Extracts containing transplantation antigens in a form that does not sensitize if administered by an appropriate route (intravenous) may sometimes prolong the life of skin homografts in mice by excitation of tolerance. Particularly important for its therapeutic indications is recent evidence that antigens administered in this form and manner act synergistically with several different immunological depressants, including x irradiation and methotrexate, in prolonging homograft survival. (BBB)

33808 RENAL HETEROTRANSPLANTATION IN MAN. Reemtsma, Keith; McCracken, B. H.; Schlegel, J. U.; Pearl, M. A.; Pearce, C. W.; DeWitt, C. W.; Smith, P. E.; Hewitt, R. L.; Flinner, R. L.; Creech, Oscar Jr. (Tulane Univ., New Orleans). Ann. Surg., 160: 384-410(Sept. 1964).

The use of chimpanzee kidneys in renal heterotransplantation into man was attempted in six patients in terminal uremia. They received grafts from donors selected on the bases of blood groups and body size. Immunosuppressive measures included azathioprine, actinomycin C, steroids, and local x radiation. Maximal functional survival of the transplant was six months. Sepsis was a more frequent and lethal complication than rejection of the grafts. Immunologic response was followed by heterohemagglutin titers and cytotoxicity studies. Pathologic studies showed tubular degeneration and interstitial edema without marked cellular infiltration or vascular changes in the transplants. This study indicates the need for caution in clinical heterotransplantation. For transplantation studies, a method for inter-

national cooperation in data-processing and data-sharing, using biomedical computers, is proposed. (BBB)

33809 THE EFFECT OF X RAYS ON THE RESPECTIVE POTENTIALITIES OF COMPETENT ECTODERM AND ITS NATURAL INDUCER IN THE EARLY AMPHIBIAN GASTRULA. Reyss-Brion, M. (College de France, Nogent-sur-Marne, France). Arch. Anat. Microscop. Morphol. Exptl., 53: 397-465(1964). (In French)

Young gastrulas of Pleurodeles waltlii were irradiated in toto with various doses of x rays. After a dose of 1170 R, the embryos were deprived of a nervous system in 95% of the cases. Higher doses do not allow survival of the embryos. To find out which anlage are affected by x rays, local irradiations were done, either on the reacting ectodermal field or on the inductive chordomesodermal field. In the first instance, differentiation of the ectoderm into nervous organs is inhibited in 86% of the cases and remains incomplete in the others. In the second instance, the inductive potentialities of the dorsal blastoporal lip is active in 100% of the cases. These results indicate that at the gastrula stage x rays are without effect on the inductor, but they change the potentialities of the competent field. In another series of experiments, the ectodermal cap of young gastrulae from Ambystoma mexicanum and from Pleurodeles waltlii were irradiated with increasing doses: 150, 300, 800, and 1050 R. Low intensity irradiations (150 to 300 R) alters the differentiation of the brain but have no influence on the differentiation of the spinocaudal formations. Medium irradiation doses (550 to 800 R) widely modify archencephalic formations and alter deuterencephalic ones even more. However, spinocaudal formations develop in 100% of the cases. A 1050-R dose completely inhibits cephalic formation. The spinal cord develops in 50% of the cases in Pleurodeles and in 25% of the cases in Axolotl. The loss of irradiated ectodermal cells' competence toward inductors, occurs according to a determined sequence which is the same for the eggs of Pleurodeles and of Axolotl: the deuterencephalic and archencephalic structures are the first to disappear. The spinal cord is still able to differentiate after rather high irradiation doses. Irradiations of the whole egg give similar results. Parabioses between normal and irradiated animals were performed, thus allowing longer survival of the irradiated animals. The irradiated animals associated with healthy ones are able to form again partially their nervous structures. However, the ectodermal cells are still unable to differentiate into cerebral structures: after an irradiation of 1050 R, they are unable to differentiate into brain whereas they still form a spinal cord in 100% of the cases. Potentialities of the chordomesodermal inductive field were also studied after an x irradiation. Dorsal blastoporal lips, irradiated with 1170, 30,000, and 150,000 R, were grafted sandwich-like, in a fragment of normal competent ectoderm. Even after the highest irradiation the blastoporal lip is able to induce the different neural or mesodermal structures found in controls. However, a diminution of frequency and size of the induced formations is observed after irradiation. It is concluded that irradiation does not modify the nature of the inductor but diminishes its inducing power. When dorsal blastoporal lips irradiated at 1170, 30,000 and 150,000 R are cultured, the explants are unable to undergo self differentiation. In the last two series, they quickly undergo necrosis. Grafts of irradiated blastoporal lips of Pleurodeles into young Discoglossus gastrulae also prove that after irradiation there is no self differentiation of the dorsal blastoporal lip. The secondary structures which develop belong to the Discoglossus type. Fragments of irradiated ectoderm were grafted in an unirradiated ectoderm to see if any kind of irradiated tissue may become an inductor. In a few cases, some neuroid structures develop but coherent formations are never obtained. These experiments show that participation of the irradiated graft, either as a tissue, or as cytolytic agent, in the differentiation of the explant can be excluded. The structures in the explant are all evoked by the inductive action of the dorsal blastoporal lip, and even intensive irradiation did not alter its quality. (BBB)

33810 EXPERIMENTAL ENTEROPATHY BY WHOLE-BODY IRRADIATION. Ballerini, G.; Castoldi, G. L.; La Paglia, S.; Ricci, N. (Universita, Ferrara, Italy). Arch. Ital. Anat. Istol. Patol., 38: 118-38(1964).

The morphological pattern of enteropathy in rats exposed to whole-body x irradiation (800 R) is described. The following phase of mucous epithelial regeneration and the behaviour of the intestinal differentiated cells (goblet cells, Paneth cells, and enterochromaffin cells) are illustrated. On the basis of these morphological data and the related literature, the cytopathogenetic mechanism of experimental x ray enteropathy and of the regeneration process is discussed and interpreted within the framework of the nonregenerative enteropathies. (Excerpta Med.)

33811 ON THE DOSIMETRY AND BIOLOGICAL EFFECT OF FAST ELECTRONS. Markus, B. Arch. Klin. Exptl. Dermatol., 219: 509-14(June 25, 1964). (In German).

Compared to an equal amount of 200-kv x irradiation, fast electrons cause less skin damage than they do at various depths beneath the skin. In this comparative sense they offer protection for the skin. Quantitative evaluation of the biological effects of fast electrons are based on observations made on objects of relatively small magnitude. However, the results are distorted very easily by a characteristic of fast electrons. This is the dose reduction caused by scattering. This effect may account for differences reported between the effects of x irradiation and fast electrons. If the dose ratio is adjusted the effects of the two types of irradiation on inhibition of mitoses or on chromosomal changes agree closely. In general, the results observed are not only quantitatively the same, but take place in the same time sequence for each type of irradiation. Although it is initially constant, the linear energy transfer increases with depth, so that for fast electrons the dose measured depends on the depth. (BBB)

33812 ATTITUDE TOWARD THE WORK OF C. G. SCHIRREN AND L. GRUBER, "FURTHER STUDIES ON THE SHORTENING OF THE WHEAL RESORPTION TIME IN THE SKIN." Wagener, H.-H. (Dermatologische Universitaetsklinik, Basel) Arch. Klin. Exptl. Dermatol., 218: 641-2(Aug. 7, 1964). (In German)

Previous work on the effects of uv and x irradiation on the wheal resorption time is reviewed and compared with experimental results. Conductivity measurements indicate that x irradiation causes effects that are additional to those caused by uv irradiation. Also, it is pointed out that conductivity measurements give more differentiated results than the apparently very complex wheal resorption time measurement method. It is pointed out that conductivity measurements are limited when used to measure events requiring prolonged periods of time for completion. (TCO)

33813 BIOCHEMICAL AND DEVELOPMENTAL RESPONSE OF GRASSHOPPER EMBRYOS AND SPERMATOGONIA TO X-IRRADIATION. Tahmisian, T. N. Argonne Natl. Lab. Rev., 2: No. 3, 52-3; 59(July 1965).

The effects of doses of x radiation ranging from 25 to 200 kR, on respiration and development of grasshopper embryos were studied, with emphasis on the radiosensitivity of various organizational stages including induction, differentiation, cell division or multiplication, anabolism, and catabolism. Degrees of complexity at each organization level are discussed and the interdependence of all factors is considered. Results are included from an electron microscopic study of normal spermatogenesis in the grasshopper and the effects of x radiation on spermatogenesis. (C.H.)

33814 VARIATION OF TECHNOLOGICAL CHARACTERISTICS OF WORKING YEAST BY ^{60}Co-RADIATION. Prosenz, K.; Gaisch, H.; Kaindl, K. (Institut fuer Biologie und Landwirtschaft, Seibersdorf, Austria). Atompraxis, 11: 277-80(May 1965). (In German)

The technological characteristics investigated show similar irradiation effects. Stimulation effects appear at 0.05 MRad, while inhibition and reduction occur at higher doses. The stimulation of gamma radiation will be mostly

found related to the time as variable. Under these circumstances the following effects may be of some importance for practice: increase of the amount of yeast in a given nutrition solution (yeast production), increase of alcohol production, and better use of the nutrient (general economic view). (auth)

33815 INFLUENCE OF ANTAGONISTS OF NUCLEIC ACID METABOLISM AND OF X RADIATION ON THE INDUCTION OF ENZYMES. Kroeger, H.; Greuer, B. (Universitat, Freiburg i. B.). Biochem. Z., 341: 190-8(1965). (In German)

About 75% of the liver was removed from adult Wistar rats, and 48 hr later the regenerating liver was used for the experiments. Five days before this operation, some rats had been adrenalectomized. Enzyme induction was stimulated by injection of L-tryptophan or L-tyrosine intraperitoneally three to four hr before the rats were killed and liver slices prepared for enzyme assays. Cortisone was injected in the adrenalectomized rats. Whole-body irradiation was carried out with 500-R doses of 200-kv x rays. Substrate induction of tryptophan pyrrolase is inhibited by actinomycin D in intact and regenerating rat liver. 5-Fluorouracil, on the other hand, is effective in regenerating rat liver only. Substrate induction of tyrosine-α-ketoglutarate transaminase is even more strongly inhibited by actinomycin D. Cortisone induction in adrenalectomized animals is blocked by actinomycin D and also 5-fluorouracil. 6-Mercaptopurine does not have any effect on these two kinds of induction; not even if administered at toxic doses. Four days after whole-body irradiation with 500 R a significant inhibition of substrate induction of tryptophan pyrrolase is observed in intact liver. This is followed by a steady decrease in enzyme activity up to the 15th day; 25 days after irradiation, however, the level is back to normal. Cortisone induction in intact animals is not influenced by irradiation at all. The results are discussed in terms of DNA and RNA involvement in enzyme synthesis, and the effect of antimetabolites and irradiation on nucleic acid synthesis. It is concluded that RNA rather than DNA is mainly implicated in cortisone induction on the basis of the known inhibitory action of radiation on DNA replication. (BBB)

33816 EFFECT OF SIDE-CHAIN DEUTERATION ON PROTEIN STABILITY. Hattori, Akihiko; Crespi, Henry L.; Katz, Joseph J. (Argonne National Lab., Ill.). (Biochemistry, 4: 1213-25(July 1965).

Thermal denaturation of protio- and deuteriophycocyanin, isolated from the blue-green algae Plectonema calothricoides, Phormidium luridum, and Synechococcus lividus, grown in H_2O and D_2O, was studied in both H_2O and D_2O. The critical temperatures of thermal denaturation of deuteriophycocyanins were always significantly lower than those for protiophycocyanins, in both H_2O and D_2O solutions. The critical denaturation temperature was shown to be higher in D_2O than in H_2O for both protio- and deuteriophycocyanins. These results suggest that substitution of hydrogen atoms by deuterium in exchangeable positions stabilizes the protein conformation, whereas introduction of deuterium in nonexchangeable hydrogen positions appears to decrease nonpolar side-chain interactions. (auth)

33817 HELIX-COIL TRANSITION OF POLY-L-GLUTAMIC ACID AND POLY-L-LYSINE IN D_2O. Appel, Pearl; Yang, Jen Tsi (Univ. of California, San Francisco). Biochemistry, 4: 1244-9(July 1965).

The specific rotations at 233 mμ of poly-L-glutamic acid and poly-L-lysine in D_2O were measured as a function of pD and compared with those in H_2O. In both cases the helix-coil transition shifted toward the alkaline side; i.e., $(pD - pH)_{tr} = \sim 0.6$. Thus, deuteration appeared to favor the formation of the helix for poly-L-glutamic acid but the coil for poly-L-lysine. This apparent contradiction was resolved by studying the titration behavior of two polypeptides. Just as in simple acids, both the glutamic acid and lysine side groups in the polypeptide chains became weaker Brønsted acids upon deuteration. The difference in the intrinsic dissociation constant, $pK_i(D_2O) - pK_i(H_2O)$, was about 0.5 for poly-L-glutamic acid and 0.7 for poly-L-lysine. When the rotations were replotted against the degree of dissociation instead of against pD or pH, the experimental data in D_2O and H_2O coincided. Thus the deuterated helices of the two polypeptides in D_2O seem to have the same stability as the protonated ones in H_2O. (auth)

33818 ACTION OF GAMMA-RAY IRRADIATION ON PHOTO-PHOSPHORYLATION REACTIONS. Goffeau, A.; Bove, J. M. (Service Biochimie I.F.A.C., Paris). Biochim. Biophys. Acta, 102: 103-15(May 25, 1965). (In French)

Through the action of γ-ray irradiation, two phenazine methosulfate (PMS) (or pyocyanin) systems of cyclic photophosphorylation can be distinguished. One of them is not affected by γ-ray irradiation of chloroplasts and represents the normal PMS system of cyclic photophosphorylation that operates at high light intensity and in the presence of an optimum concentration of cofactor. By its resistance to γ-ray irradiation, the normal PMS system appears to be different from the normal vitamin K_3 system. The other PMS system is affected by γ-ray irradiation; it functions either at low light intensity with an optimum concentration of PMS or high light intensity with a suboptimum concentration of PMS. By its sensitivity to γ-ray irradiation, this system resembles the vitamin K_3 system of cyclic photophosphorylation and the systems of noncyclic photophosphorylation which are all 50% inhibited by the same dose of irradiation (130 krad). (auth)

33819 CELLULAR PROLIFERATION IN NORMAL AND CONTINUOUSLY IRRADIATED RAT BONE MARROW STUDIES BY REPEATED LABELLING WITH TRITIATED THYMIDINE. Lord, B. I. (Royal Cancer Hospital, Belmont, Eng.). Brit. J. Haematol., 11: 130-43(Mar. 1965).

A single injection of tritiated thymidine can be used to label all cells which are in the S phase of their generative cycle, and by giving repeated injections, all cells which are passing through a generation cycle will eventually become labeled. This principle was used for investigating the patterns of proliferation of the erythroid and myeloid cell series in bone marrow of continuously irradiated rats. In a previous report it was shown that continuous whole-body γ irradiation increased the mean proliferation rate of the marrow cells, as seen by a shortened mean cycle time of the proliferating cells. The present experiments were designed to investigate further the extent to which the increased percentage labeling of nucleated cells in bone marrow following continuous irradiation can be interpreted in this way. F_1 hybrid male rats of the inbred August and Marshall strains (about 6 to 7 weeks old) received intraperitoneal injections of 50 μC of tritiated thymidine at intervals of 4 or 5 hr for about 50 hr. Two hours after each injection some animals were killed and femoral bone marrow smears prepared for autoradiography. As reported earlier after continuous whole body γ irradiation, the proportion of cells taking up thymidine doubled after 35 days at 50 rad or after 15 days at 84 rad/day. Thus these two points represent the start of new staedy state conditions in the bone marrow. A dose rate of 50 rad/day represents a threshold value, in that it may or may not produce death by bone marrow failure. Results at 84 rad/day appeared to be more reproducible, so it was decided to use the higher dose rate for repeated labeling studies. Consequently, the animals were irradiated for 15 days at 84 rad/day in a ^{137}Cs unit. Comparison of the rates of increase of labeling in each of the erythroid and myeloid cell compartments showed that, with the exception of myeloblasts, maximal labeling was sooner when the animals had been irradiated. In the erythroid series, maximal labeling was reached at about 27 hr in the control pronormoblasts, and following irradiation they are fully labeled at 10 hr. Also, in the irradiated animals, the labeling index increases rapidly from about 60% to 80% in the interval between 1 and 2 hr after the first injection. Since no thymidine was administered during this period, the increased positivity is due to the division of labeled cells and, therefore, a $(G_2 + M)$ period of between 1 and 2 hr exists for most of the pronormoblasts in the irradiated animals. There was no difference at this

interval for any other cell type so the 2-hr observations are probably within the G_2 periods for those cells. For early normoblasts it takes 50 hours before all the cells are labeled, but in irradiated animals they are fully labeled in 10 or 12 hours, 90% of them being labeled by 6 hr. The rate of increase of labeling is about 1.2% per hr compared with 3.4% per hr following irradiation. In the myeloid series the myeloblasts and promyelocytes are fully labeled in the control animals by about 19 and 24 hr respectively. After irradiation, the myeloblasts have the same initial labeling as the controls and it remains fairly constant as administration of thymidine is repeated. Nearly all the promyelocytes are labeled by 12 hr after a slightly higher initial labeling than in the controls. The myelocyte labeling increases linearly, reaching 100% labeling after 53 hr. Following irradiation, the labeling is initially doubled and for 10 hr increases more rapidly than normal and 100% labeling is approached at about 50 hr. The metamyelocytes show a uniform increase in labeling index at a rate of about 0.9% per hr for 35 hrs; then there is a sudden rapid increase and the labeling reaches 100% at 53 hr. In the irradiated animals, the initial labeling is increased fourfold and the rate of increase of labeling doubled. (BBB)

33820 THE EFFECT OF 6-MERCAPTOPURINE ON CANINE RENAL HOMOTRANSPLANTS. Lowry, J. B.; Bridges, J. B. (Queen's Univ., Belfast). Brit. J. Surg., 51: 533-8(July 1964).

The use of bone-marrow transplants in dogs undergoing renal homotransplantation with immunologic suppression therapy by 6-mercaptopurine (6-MP) is described. Small rodents can survive after minimal lethal x irradiation if injected with suspensions of hematopoietic cells, and survival is largely, if not completely, due to the persistence, proliferation, and function of the injected foreign cells. Attempts have been made to utilize these results clinically either to correct marrow aplasia resulting from accidental exposure to x irradiation, in the therapy of leukemia, or to attempt renal transplants. However, successful marrow homografting has not been so readily achieved clinically as with small rodents. In this respect the dog, the most frequently used animal for renal homografting experiments, retains the capacity to reject renal grafts after exposures up to 1000-R irradiation. Supralethal x irradiation of 1300 R is necessary to prevent the destruction of a renal homograft by immunological mechanisms while the animal needs the supporting therapy of a successful marrow homograft. Attempts have been made to substitute cytotoxic drugs for x irradiation in the hope of achieving similar depression of the host's immunological responses to homologous (allogenic) grafts, and prolonged skin homograft survival occurs in animals treated with 6-MP. This drug has been successfully used to prolong canine renal homografts, but continuous therapy with 6-MP causes severe marrow aplasia and jaundice. Attempts were made to reduce the incidence of toxic effects by giving a short course of the drug and counteracting the resulting marrow depression by marrow transplantation. The mode of action of 6-MP in modifying the fate of a canine renal homograft was further studied by treating the donor prior to grafting in some animals and the kidney recipient in another series. A total dose of 25 mg/kg of 6-MP administered in 8 days to recipient or donor dogs, completed before transplantation, had no effect on the subsequent fate of a renal homotransplant. Treatment started one day before transplantation increased the mean functioning time of the renal homotransplant from 4.7 to 8.3 days. The recipient dogs showed severe leucopenia, lymphoid aplasia, loss of weight, and infection, but the intensity of the homograft reaction was less marked. On the other hand, removal of the remaining kidney and intravenous injection of homologous marrow six days after grafting increased the mean functioning time of the homotransplant to 15 days. In this series the dogs died with uremic symptoms while the homotransplanted kidneys were still functioning. Post mortem examination revealed a mild homograft reaction. Injection of homologous marrow suspensions did not dramatically alter the blood picture but seemed to be responsible for further prolongation of renal homotransplant survival. (BBB)

33821 FACTORS AFFECTING THE ANTIBODY RESPONSE. White, R. G. (London Hospital). Brit. Med. Bull., 19: 207-13(Sept. 1963).

The effect of physical and chemical factors, especially adjuvants, corticosteroids, and ionizing radiation, on antibody formation is reviewed. The most extensively studied of the agents which interfere with the production of humoral antibody are irradiation by x rays and corticosteroids. However, all such agents affect many tissues of the body besides the reticular tissues. The activity is therefore far from a specific effect. Study of the effect of x rays on antibody production began in 1908 when it was observed that the primary response to whole serum in rabbits was much depressed, and that the rate at which antigen disappeared from the circulation was delayed when antigen was injected two to four days after whole-body irradiation. In contrast, antibody production was unaffected by irradiation timed four days after antigen injection. In the early 1950's, several investigations supported the concept of a radiation-sensitive primary response contrasting with a relatively resistant secondary response. Thus, after 380 R of whole-body irradiation to the rabbit on day before a primary stimulus of staphylococcal toxoid injected intravenously, it was found that the antitoxin response was completely prevented; toxoid given three to four weeks later failed to provoke a secondary response. The same dose of irradiation given one day before a secondary stimulus produced relatively little effect. Thus, irradiation before a primary stimulus can prevent the multiplication of immunologically competent cells or the buildup of potential immunity required for a secondary response. This action of x rays is possibly related to the inhibition of the formation of germinal or lymphocytopoietic centers and of fresh lymphocytes. The effect of x rays depends critically upon its timing relative to the administration of antigen. From two hr before to one day after x-ray treatment there is increasingly effective depression. During this interval the power to form antibody disappears, with a half life of less than two hr. The sensitivity of the so-called pre-induction phase of the immune response, a short period immediately after antigen injection during which some necessary event takes place to initiate the rest of the process, has been related to the localization of the antigen in the antibody-forming sites or to the early metabolism of the antigen. Since x rays have a damaging effect on DNA function, there is a general belief that most of the biological effects of irradiation are secondary to its action on DNA. RNA turnover and protein synthesis are apparently not much affected. Factors which may be associated with the initiation of the immune response include nucleic acids and their derivatives in spleen tissue minces and yeast extracts, and enzymically degraded DNA and RNA. When these were injected together with antigen into rabbits irradiated one day previously with 400 R, antibody formation was mainly restored. A release of nucleic acid derivatives at critical times in relation to the administration of antigen may explain the increased amounts of antibody formed in rabbits given total-body irradiation two hr before injection of antigen. (BBB)

33822 RADIATION MYELOPATHY. Rider, W. D. (Princess Margaret Hospital, Toronto). Brit. Med. J., 1: 1071(Apr. 17, 1965).

There are two now clearly delineated forms of radiation myelopathy. Historically the first is that described by Druckmann in 1929, in which symtoms and signs of interruption of physiological pathways in the central nervous system are found within weeks after irradiation, and which most commonly proceed to complete recovery. The second form might be called the Pennybaker-Boden syndrome; the clinical picture here develops months after irradiation and proceeds to permanent damage, which will be fatal if vital centers are involved. The essential difference pathologically is that the former picture is associated with demyelination and the latter with nerve degeneration secondary to blood-vessel damage. It is only rarely that the demye-

lination produced by radiation is permanent, but without careful follow-up and detailed necropsy it is likely that some cases are missed, so that the true incidence is not known. The remarkable similarity of Lhermitte's sign occurring in multiple sclerosis and the same picture produced by cord irradiation would add credence to the concept that the first form of radiation myelopathy is a radiation-induced demyelination. It is now necessary to separate these two forms of radiation myelopathy, at least by name, into: (1) radiation demyelination and (2) radiation neurovasculitis, or similar terms to indicate the differences in pathogenesis. (BBB)

33823 M.R.C. RADIATION RESEARCH UNIT. Brit. Med. J., 1: 1431(May 29, 1965).

A description is given of some phases of research conducted at the Medical Research Council (M.R.C.) Clinical Effects of Radiation Research Unit at the Western General Hospital, Edinburgh. The Unit was set up in Edinburgh in 1956 to continue studies of radiation effects. Studies on frequency and etiology of chromosomal aberrations in man are given particular emphasis. (TCO)

33824 ACCELERATION OF THE EVOLUTION OF LYMPHOGENIC LEUKEMIA INDUCED BY X RAYS IN C57 BLACK MICE BY MEANS OF NONCELLULAR LEUKEMIC TISSUE EXTRACTS. Laznicka, M.; Smetanova, R. (Inst. of Hematology, Prague). Bull. Assoc. Franc. Etude Cancer, 50: 651-8(Oct.-Dec. 1963). (In French)

Attempts were made to accelerate the development of La VUFB leukemia (which had been induced by x radiation), in mice inoculated with leukemic cells, by prior injection of cell-free extracts from leukemic mice. These studies were prompted by the finding that the spontaneous leukemia in AkR mice can be accelerated by injection of such extracts. Thus, a filterable agent was sought in the radioinduced La VUFB leukemia. The spleen, thymus, and lymph nodes of a leukemic male C57B1 mouse were homogenized and suspended in nonpyrogenic physiologic solution. This was centrifuged and filtered to obtain the acellular extract. Four groups of mice were used: (A_1) ten males and ten females were each injected with 0.2 ml nonpyrogenic physiologic solution; (A_2) ten males and ten females were each injected with 0.2 ml acellular leukemic tissue extract; (A_3) ten males and ten females were injected with 0.2 ml acellular extract from healthy mouse spleens; and (B) 11 male and 12 female newborn mice were each injected with 0.1 ml acellular leukemic tissue extract. After several weeks the A groups were injected with a suspension of La VUFB leukemic cells. In group B, leukemia appeared in 44% of the mice, after an average latency of seven months, whereas spontaneous leukemia normally appears in only 4% of this strain. All (100%) the mice in the A groups died of leukemia. Group A_2 had a median survival time of nine days, while that of groups A_1 and A_3 was ten days. The prior injection of the noncellular extract accelerated the development of the leukemia by one day. The weight of the livers of group A_1 varied from 7.1 to 10.3 g (per 100 g body weight) and the spleens varied from 3.1 to 5.2 g. Group A_2 livers weighed 7.5 to 15.1 g and the spleen weights, 3.6 to 7.2 g. In group A_3 the livers weighed 2.5 to 6.1 g. The leukemic-extract injected group showed the greatest increase. The injection of La VUFB morphological characteristics of the originally radioinduced La VUFB leukemia transmitted by cells. (BBB)

33825 THE INFLUENCE OF IONIZING RADIATION ON THE DIURNAL RHYTHM OF MITOTIC ACTIVITY IN THE MOUSE CORNEAL EPITHELIUM. Mastryukova, V. M.; Strzhizhovskii, A. D. Bull. Expti. Biol. Med. (USSR)(English Transl.), 58: 858-60(July 1964).

Translated from Byul. Eksperim. Biol. i Med., 58: 106-9(July 1964).

The mitotic index (number of mitoses per 1,000 cells) of the corneal epithelium of the control animals varied during the day from 15.75 ± 0.69 at 8.00 h to 4.18 ± 0.33 at 20.00 h, i.e., almost fourfold. One day after local irradiation with 200 R there were no longer any diurnal variations in mitotic activity. By the fourth day after irradiation there was some recovery, and finally, by the tenth day the normal rhythm was reestablished. Similar results were observed when the dose was 700R. (C.H.)

33826 EFFECT OF GAMMA-IRRADIATION ON THE RNA CONTENT OF EUGLENA CELLS. Matsuoka, Saburo (Gifu Univ., Japan). Bull. Inst. Chem. Res., Kyoto Univ., 43: 17-21(Jan. 1965).

The RNA content of non-irradiated growing cells changes during the growth cycle. In most cases, it reaches a maximum in the logarithmic phase. Thus, the cells of the logarithmic phase generally contain more RNA than those of the stationary phase. When the cells in these two growth phases, logarithmic and stationary, were irradiated by the gamma rays at 1×10^5 R, the RNA content per cell decreases by about 30% in the 6 hours after irradiation of the cells of the logarithmic phase. The rate of RNA decrease seemed to be proportional to the RNA content of the cells before the irradiation. The RNA content of the irradiated cells remains unchanged for a period ranging from 12 hours to 11 days after the irradiation. No change in the RNA content per cell was observed after irradiation of the cells of the stationary phase. (auth)

33827 CHROMOSOME BREAKAGE BY P^{32}. Jona, R. (Universite, Louvain, Belg.). Cellule Rec. Cytol. Histol., 64: 343-56(1964).

Vicia faba plants, grown for 10 to 15 days in a mineral medium (vermiculite), were treated with an aqueous solution of $Na_2H^{32}PO_4$ (2 μC/ml.) for 2 to 3 days. The effect produced by the incorporation of ^{32}P in the chromosomes of Vicia faba was analysed. Chromatid breaks were the first and most important aberration noted. The β-rays seem to affect chromosomes in a selective way, as breaks are more frequent at particular points on the chromosomes. Often these points are those which, after a long pretreatment with cold, are said to be heterochromatic. Other effects of ^{32}P are: the micronuclei, probably deriving from acentric chromosomal fragments; the influence on anaphasic chromosomes, stopping their development only in one of the two sister-nuclei; last, the appearance of anaphasic bridges. The ^{32}P mode of action is discussed and compared with that of other mutagenic agents. The aberrations produced are related to several theories on the chromosome structure and especially to the two stranded theory, to evaluate the elements supporting it. (Excerpta Med.)

33828 TRYPSIN INHIBITOR LEVELS AND HOMOGRAFT REJECTION. Tyler, H. M.; Nemeth, A.; Kapros, C.; Kountz, S. L.; Dempster, W. J.; Silvester, J. Ann (Postgraduate Medical School, London). Clin. Sci., 26: 315-21(Apr. 1964).

A sharp drop in serum trypsin inhibitor (STI) is an early indication of homograft rejection in the dog, often occurring 24-48 hr before oliguria. The possible value of STI measurements as a routine clinical test for impending homograft rejection was investigated since human recipients of renal homotransplants are usually modified by such measures as total-body x irradiation, local x irradiation to the transplanted kidney, cortisone, and/or antimetabolic drugs. The possible effects of these treatments on the STI level were studied in dogs. Eight dogs received 50 to 100 rad total-body x irradiation 24 hr prior to receiving a homotransplanted kidney. Local x irradiation (200 rad) was given to the kidney immediately following transplantation; some dogs received further local irradiation (100 or 200 rad) to the kidney at various times after transplantation. Three dogs received a homotransplanted kidney and one or more local irradiations (200 rad) to the kidney; the first irradiation was always given immediately following transplantation. All dogs received 25 to 100 mg prednisone per day throughout the survival period of their homotransplanted kidney, and some unoperated dogs received 100 mg prednisone daily for 7 days. X rays from a 8-Mev linear accelerator were used to give whole-body and local irradiations to the dogs. The output of this machine was 100 rad/min at 100 cm from the target and this peak dose-rate occurred at a depth of 2 cm in tissue. The local irradiations to the transplanted kidney were also given. Predni-

sone caused a marked rise in STI following homotransplantation in dogs, modified by total-body and local x irradiation. Dogs in which the rejection process was modified by total-body and local x irradiation did not show a terminal fall in STI. The rise in STI which follows homotransplantation in man is probably mostly due to the effects of surgery. No fall in STI occurred in two patients whose rejection process was modified by x irradiation. One patient treated by x irradiation, in whom it was thought a rejection may have been occurring 9 months following homotransplantation, showed a 50% reduction in STI level during a critical 3-week period. As the patient recovered, STI and blood urea returned to normal limits. In two other patients treated with antimetabolic drugs and whose rejection process appeared to remain essentially unmodified, falls in STI were seen about the time rejection is thought to have occurred. It is concluded that more data are required to confirm whether the STI test is of value in helping to confirm rejection in man. (BBB)

33829 CHEMICAL REACTIVITY OF CHROMOSOMAL DNA AS RELATED TO MUTAGENICITY: STUDIES WITH HUMAN CELL LINES. Szybalski, Waclaw (Univ. of Wisconsin, Madison). Cold Spring Harbor Symp. Quant. Biol., 29: 151-9(1964).

A large number of mutagenic agents active in microbial systems was found to be ineffective in increasing mutation rates when tested with several selective mutational systems developed for in vitro grown human cell lines. These include x ray, uv light, and several other agents known to be mutagenic in bacterial and phage systems. In addition, a series of powerful carcinogens was also assayed, as were a few other biologically active but not necessarily mutagenic compounds: colchicine, a mitotic inhibitor; Synkayvite, a purported radiosensitizer; and strophanthin, a cytotoxic glycoside. Cell inocula growing on glass or plastic surfaces were exposed for various periods of time to the radiation or chemical agent, under conditions permitting 5 to 90% survival. Only in the case of x rays was a consistent, although very low mutagenic effect observed. Several possible explanations for this general lack of mutagenic effect for human somatic cells were explored and excluded on the basis of the experimental results; e.g., it was found that several mutagenic agents employed, including radiation, thymidine analogs, and natural, bifunctional alkylating agents, the mitomycins, and porfiromycin, are quite reactive towards the chromosomal DNA component of living mammalian cells. The most probable basis for this insensitivity to mutagenic agents resides in the special, mutagen-indifferent mechanism of numerically predominant spontaneous mutations in populations of somatic mammalian cells. The spontaneous mutation rates for the systems studied were high, approaching 10^{-3} mutations/cell/generation. It was found that in mammalian cells the DNA component is most probably the principal target of lethal radiation effects, as inferred from radiosensitization of the cells by DNA-incorporated halogenated thymidine analogs. (TCO)

33830 SYNTHESIS OF DNA-LIKE RNA IN X-IRRADIATED NON-DIVIDING YEAST CELLS. Robev, S.; Dessev, G. Compt. Rend. Acad. Bulgare Sci., 17: 474-7(1964).

Radiosensitivity of messenger-RNA synthesis in yeast is reported. Baker's yeast was irradiated with 220-kv x rays to a dose of 120 kR. The cells were then incubated with ^{32}P-phosphate and fractions of RNA and DNA isolated. The RNA was hydrolyzed with 0.5M potassium hydroxide at 37°C for 20 hr, and the mononucleotide solution was chromatographed on Dowex 1 columns with 0.4 M HCOOH, which gives the nucleotide fractions in the following sequence: cytidylic, adenylic, guanylic, and uridylic acid. The nucleotide composition was determined by spectrophotometry, as percentage of cytidylic acid, adenylic acid, guanylic acid, and uridylic acid. The specific RNA activities of the irradiated and control cells were compared with the total activity of the four nucleotides obtained from RNA hydrolyzates. The respective percentages of these four mononucleotides from irradiated cells were: 23.3, 27.4, 21.3, and 27.8; for nonirradiated cells 22.3, 31.2, 20.3, and 26.3. The results show that normal as well as irradiated yeast cells synthesize RNA, whose nucleotide composition resembles that of the yeast DNA and differs markedly from that of the total RNA. This indicates that, under the conditions used, the synthesis of DNA-like RNA predominates. The ^{32}P incorporation in RNA in the irradiated cells was 48% of the value of the controls. The inhibition observed is the result of the action of the ionizing radiation on cellular metabolism, and not the effect of cell death since control experiments showed that this dose of x rays kills relatively few nondividing cells. (TCO)

33831 MORPHOLOGICAL STRUCTURAL CHANGES AT THE ENAMEL-DENTIN BORDER AFTER RADIATION TREATMENT. Osswald, M. (Ernst-Moritz-Arndt Universitaet, Greifswald, Ger.). Deut. Stomatol., 13: 723-30(1963). (In German)

At about 6 months after exposure to between 1500 and 5000 R of x-radiation the hard tissues of teeth showed evidence of damage. The changes had certain regularities. These consisted of an opaque whitish line at the neck of the tooth, which could scarcely be differentiated from an initial process of decalcification that indicates the beginning of caries in caries-susceptible teeth. The free enamel surfaces lost their brightness and appeared dull and rough. These effects were also observed in teeth that had been outside of the irradiation field. The upper surfaces of the teeth were blunt and rough, with a milky turbidity and appearance of chalkiness. Over a period of time these changes affected the entire crown. By scrapping with a dental probe it was possible to remove material from the enamel and dentin. Later on it was possible to remove lamellae of the enamel layer with an excavator. Sometimes the enamel broke away from the dentin body. This retained its anatomical shape, but was rather elastic and gave an echo when tapped. It was possible to penetrate the dentin easily with a probe. The light microscope was unsuitable for detailed study of these changes because it did not have sufficient resolving power. These changes were studied in greater detail by means of the electron microscope. (BBB)

33832 A COMPARISON OF GENERAL AND GENETIC RADIOSENSITIVITY IN TWO STRAINS OF MICE. Vorobtsova, I. E. (Central Scientific-Research Roentgen-Radiological Inst., USSR). Dokl. Akad. Nauk SSSR, 160: 1187-90 (Feb. 11, 1965). (In Russian).

The contradictory findings reported in the literature concerning the correlation between the general and genetic radiosensitivity of animals is due to the marked variation of the mean lethal dose DL_{50} for the same species; the chromosome resistance depends on the stage of the cell development cycle. These factors were not considered in the past, and different organisms were compared. In order to draw valid conclusions on this subject, the general and genetic radiosensitivities of two strains of mice, C57B and BaLB were compared. The frequency of the dominant lethal mutations in the spermatozoids of the irradiated males, exposed to 200 R, was used as the genetic sensitivity indicator, on the basis of surviving embryos after implantation into females. The number of animals dying within 30 days after a single exposure to 800 R served as the criterion of the general sensitivity. A statistical treatment of the results indicated a true difference between the two types of radiosensitivity of the two strains. It was concluded that there is a definite correlation between the two radiosensitivities. (TTT)

33833 DISTRIBUTION OF AFFERENT AND EFFERENT FIBERS IN THE CEREBRAL CORTEX OF THE RABBIT REVEALED BY LAMINAR LESIONS PRODUCED BY HEAVY IONIZING PARTICLES. Kruger, L.; Malis, L. I. (Univ. of California, Los Angeles). Exptl. Neurol., 10: 509-24 (1964).

Patterns of Marchi degeneration following laminar lesions of the cerebral cortex of rabbits were studied in order to delimit the arrangement of afferent fibers. Pericellular nests of Marchi granules above laminar lesions appear to represent the preterminal portion of ascending fibers and the number of such degenerating fibers increased with deeper lesions or higher doses of radiation. Although as-

cending fiber degeneration can be demonstrated extensively in the supragranular layers, severe disruption of fibers and complete destruction of neurons in these layers does not result in retrograde thalamic atrophy, suggesting that termination in the granular and infragranular layers are sufficient for sustaining thalamic neurons. The Marchi degeneration in the thalamus following lesions of the supragranular layers represents descending degeneration of corticothalamic fibers. Corticothalamic fibers have been shown to arise from all cellular layers of the cerebral cortex, but the largest contribution of these fibers is observed with lesions which involve the infragranular layers. Degeneration traced from the sensorimotor cortical fields to the substantia nigra appears to possess a predominantly infragranular layer origin. Results support the differentiation of the laminar organization of the sensory cortical fields into a predominantly, but not exclusively, afferent role for the granular and supragranular layers, and an efferent role for the infragranular layers. (Excerpta Med.)

33834 ALTERATIONS IN SPINAL CORDS OF NEONATAL RATS FOLLOWING X-IRRADIATION. Rodgers, Charles H. (Univ. of Arkansas, Little Rock). Exptl. Neurol., 11: 502-15(Apr. 1965).

Three-day-old rats were irradiated with a single dose from a Grenz-ray (15-kv) machine with a lead shield with an aperture 5 × 10 cm protecting all but the lumbar portion of the spinal cord. The doses varied from 500 to 4000 R. Neurologic, histopathologic, and biochemical changes were followed to determine the smallest dose of soft x rays that would induce significant changes by 9 to 11 days postirradiation. All animals receiving 3000 and 4000 R developed paresis or paralysis of the hind limbs by this time. A marked decrease in incidence of grossly visible neurologic abnormalities was observed in those animals receiving 2000 R and no abnormalities were seen in the 1000- and 500-R groups. Thus, the minimal amount of x radiation needed to produce consistent, severe neurologic alterations within this time period would be between 2000 and 3000 R. Microscopic studies of spinal cords at 11 days following irradiation showed that 2000 to 4000 R reduced markedly the quantity of neuroglia and myelin in the irradiated regions. Spinal cords receiving 500 or 1000 R appeared to be normal. A dose between 1000 and 2000 R was considered to be the minimal amount needed to produce histopathologic changes. Total lipid following administration of 4000 R decreased and a greater than normal amount of water was found in the irradiated zone. This marked decrease in lipid in irradiated spinal cords correlated with a reduction amount of histologically demonstrable myelin in rats killed at 11 days following irradiation. An abnormal vertebral column was noted in the 63-day-old rats that had received 2000 R, and if these animals had been allowed to live longer perhaps late or secondary neurological changes would have resulted from impingement of the malformed vertebral column upon the spinal cord. Animals killed at 30 or 60 days following irradiation with 2000 R had normal spinal cords. In contrast, those animals killed at 11 days following x irradiation with 2000 R had marked morphological changes in the spinal cord. This indicates that within a period of 19 days (from 11 to 30 days postirradiation) neuroglia has developed in or migrated into the irradiated portion of the spinal cord and have myelinated the axons in this area. The neuroglia cells could have developed from the cells in the area of the central canal in or adjacent to the irradiated region. This is the first report of delayed myelination within the central nervous system after irradiation. (BBB)

33835 EFFECT OF X-IRRADIATION ON TRYPANOSOMA LEWISI INFECTION IN THE RAT. Tempelis, C. H.; Lysenko, M. G. (Univ. of Wisconsin, Madison). Exptl. Parasitol., 16: 174-81(Apr. 1965).

The course of infection in rats treated with x rays and infected with the Becker strain of T. lewisi was studied. The Becker strain is characterized by a relatively short reproductive period and duration of infection. The immune response was followed by measuring agglutinin production, and the level of blood glucose was studied as a possible secondary feature that may contribute to the increase in intensity of the trypanosome infection brought about by x irradiation. In most experiments the rats were exposed to 300-R total-body 175-kv x irradiation 24 hr before inoculation. In one experiment the animals were exposed to a second dose of 200-R total-body irradiation on Days 5 or 10 of the infection. Results showed that the single exposure to sublethal irradiation caused a great increase in the parasitemia, an extension of the period of reproduction, and a delay in the appearance of agglutinins. Blood glucose studies showed the development of a hyperglycemia after Day 14 in irradiated and infected animals. Additional x irradiation, 200 R administered 5 or 10 days after establishment of the infection, did not further inhibit the production of ablastin or the trypanocidal antibody. On Day 7 a lower percentage of reproducing forms was observed in the group receiving 200 R on Day 5 when compared with the group receiving additional radiation on Day 10. This may have been the result of a greater degree of susceptibility of the reproducing forms to irradiation or of a destruction of antibody-producing cells with the subsequent release of ablastin. There was also evidence of a depressing effect on the phagocytic ability after 200 R on Day 5. This group exhibited a peak parasitemia twice as great as that observed after 200 R on Day 10. This was present without an increase in the reproducing rate. During hyperglycemia the rats suffered the greatest effect from the combination of irradiation and infection. From Days 11 to 16 the animals underwent a rapid loss of weight and had difficulty controlling their body temperatures, and it was during this period that animals died. Thus it seems that the hyperglycemia resulted from the combined effect of high parasitemia and the second phase of irradiation. (BBB)

33836 EFFECT OF X IRRADIATION ON THE COURSE OF EXPERIMENTAL VACCINE ANTHRAX. Vancurik, J. (Military Inst. of Hygiene, Epidemiology, and Microbiology, Prague). Folia Microbiol. (Prague) 9: 164-72(May 1964).

The effect of irradiation on vaccine infection in rabbits, using living anthrax vaccine, was studied. In particular, an attempt was made to determine the specific features of vaccine anthrax in irradiated animals. A spore suspension of the nonproteolytic Soviet vaccine strain STI was used. The rabbits received 400- or 600-R doses of whole-body 180-kv x radiation. In nonirradiated rabbits, vaccine infection following the subcutaneous administration of 5×10^8 spores was entirely free from complications, with no hyperthermia, leucocytosis or loss of weight. The process remained localized and the microorganisms infiltrated into the blood only on the first days after vaccination, very irregularly and in low concentrations. In roughly half the rabbits, a small, externally palpable infiltrate measuring about 1 × 1 cm was formed and hyperemia and hemorrhage were present in the subcutaneous tissue. Irradiation caused significant deterioration of the course of vaccine infection, particularly in relation to the radiation dose. In 32 rabbits irradiated with 400 R, three (9.3%) died, while in 26 irradiated with 600 R, 23 (88.4%) died. Lethal complications were most frequent following inoculation on the sixth day after irradiation, when the death rate in the group irradiated with 600 R was 96%. The most marked change in vaccine anthrax infection in irradiated animals was massive infiltration at the site of vaccination within two days after inoculation, which measured 5-10 cm in dia and sometimes extended to the other hind limb and the thorax. The histological findings were identical with the picture of virulent anthrax. Acute deterioration of the local phase and the formation of edematous infiltrate was the first and commonest complication in irradiated rabbits. It was most evident in the group irradiated with 400 R, in which defense mechanisms were not injured to such an extent as to make the localization of vaccine infection and prevention of its generalization impossible. Irradiated rabbits did not die from vaccine anthrax until after three to nine days (usually on the seventh to the eighth day), whereas in virulent anthrax death occurs much sooner (within two to three days). Thus, these experiments show that infection of irradiated rabbits with a vaccine strain can give rise to a disease bacterio-

logically, clinically, histologically, and biochemically identical with typical anthrax, and that anthrax toxin can be demonstrated in the plasma of dead rabbits. The main cause of anthrax sepsis is not increased sensitivity to the toxin, but the high degree of proliferation of the microorganism in the irradiated organism. Explanation of enhanced susceptibility of irradiated rabbits to anthrax is based on the postirradiation change in the cellular defense components: decreased proliferation of the phagocytic elements of the reticuloendothelial system and inhibition of the ability of phagocytes to digest engulfed microorganisms. (BBB)

33837 COMPARATIVE X-RAY AND CLINICAL FINDINGS IN RADIO-OSTEOMYELITIS OF THE MANDIBLE. Obwegeser, Hugo (Universitat, Zurich). Fortschr. Kiefer- Gesichtschir., 8: 148-53(1962). (In German)

Repair of tissues of the jaw, which have undergone destruction as a result of excessive doses in radiotherapy, is described and illustrated with reference to several cases. One patient who had received 4000- and 3500-R doses suffered severe mandibular necrosis and required transplantation of rib bone to the mandible. In considering the surgical treatment of radionecrosis of the lower jaw in adults, the author suggests that delay until sequestration occurs frequently leads to unnecessary loss of bone and soft tissues. The opinion is also expressed that as a result of progressive inflammatory changes bone may become necrotic which would otherwise have been capable of survival, even though damaged by radiation. Therefore, early removal of bone involved by radio-osteomyelitis is recommended. In order to delimit the involved bone, saw cuts are made into the bone some distance from the necrotic area through the cortex into the spongiosa until bleeding is obtained. The processus muscularis is divided. A piece of wire bent back upon itself is used to stabilize the fragments and suitable conditions for reconstruction are obtained. The wire becomes incorporated in the tissue, even in the presence of a fistula, and may serve as a soft tissue support in the event of total destruction of the lower jaw. Photographs illustrating the progress of such reparative procedures are provided. (BBB)

33838 MUTATION GENETICS. Loebbecke, Ernst-Arnold (Kernforschungsanlage, Julich, Ger.). Fortschr. Zool., 17: 155-88(1964). (In German)

The fundamental reasons for the interest which has been taken in mutation genetics recently is the development of nuclear techniques, construction of research reactors and power reactors, and the continuously increasing use of radioisotopes in industry, medicine, and the sciences. These uses raise the questions of permissible irradiation limits, effects of irradiation on living tissues, and irradiation effects on genetic factors. An important addition to these possible effects is the study of the role of irradiation in molecular biology. The author reviews the published reports on mutation genetics that have appeared during the period from 1956 to 1963. The major portion of the review is devoted to reports of mutations produced by irradiations from ^{60}Co, x irradiation, fast electrons, etc at doses ranging from 600 to 25000 R. The effect of irradiation to produce mutations of cells that are in various states, such as during spermatogenesis, oogenesis, and embryonal development is reviewed. The induction of reverse mutations is discussed. Effects of secondary, environmental factors, such as the effect of O_2 and of temperature differences are included in this review. Other radiations, including α particles, β radiation, and uv light that may also produce mutations are reviewed. (197 references.) (BBB)

33839 TEMPORAL CHANGES IN THE TISSUE PICTURE OF THE HYPOPHYSIS AFTER RADIOGOLD IMPLANTATION. Dominok, Gottfried W. (Pathologische-Anatomisches Institut am Hufeland-Krankenhaus, Berlin). Frankfurter Z. Pathol., 73: 269-78(Jan. 22, 1964). (In German)

Encapsulated ^{198}Au seeds were implanted in the hypophyses of 11 cancer patients with hormone-sensitive tumors. From 1 to 2 seeds, each containing from 15 to 70 mC were used. Survival of the patients varied from 5 hr to 18 months after the implantation. In patients who died at 5 and 10 hr after the treatment, the amount of hypophyseal necrosis was estimated to be 1 or 2%. Within a distance of 200 μ of the implantation site the parenchymal cells and nuclei were distended, and some were disintegrated. Little pyknosis was observed. Most frequently, the β cells were markedly ballooned, and contained many vacuoles. The α and γ cells were not affected as much. No changes were observed at a distance of more than 1 mm. After 10 days about 14% of the hypophysis was necrotic. There were extensive unnucleated and structureless areas, but the border of the necrotic area was poorly defined. Many cells were pyknotic, but few were ballooned. Mesenchymal or epithelial cell proliferation was absent, and only a few leucocytes or lymphocytes were observed. In 2 cases where more than 90% of the hypophysis became necrotic after 27 days and 9 weeks, respectively, the α, β, and γ cells could still be detected, and there was infiltration of round cells. Small hemorrhages were seen even after 2 months. After 4 or 5 months the zone of necrosis remained almost unchanged. Blood vessel remnants were observed. At the very later times the necrotic area became encapsulated with connective tissue, and septa containing capillaries, fibroblasts, and fibrocytes invaded the area. Parenchymal cells and the neurohypophysis were only slightly affected. A hyperemic border, leucocyte wall, and granulation tissue were never observed. (60 references) (BBB)

33840 SEX SPECIFIC BACTERIOPHAGES OF E. COLI K 12. VI. UV, X-RAY, AND NITROUS ACID INACTIVATION OF PHAGE μ_2. Turri, M.; Maccacaro, G. A.; Dettori, R. (Universita, Milan). Giorn. Microbiol., 12: 165-74 (July-Sept. 1964).

The inactivation of phage μ_2 by three different agents known to be active on the nucleic acids has been studied. The inactivation process by uv light, x rays, and nitrous acid follows one-hit kinetics and the relative sensitivity of μ_2 vs T_6 is 0.035, 0.22, and 0.05 respectively. After exposure to uv light phage μ_2 appears to be nonphotoreactivable. The sensitive volume of phage μ_2 determined in x-ray inactivation experiments is 7.3×10^{-13} cm^3, a value which correspond to the entire volume of the phage particle calculated from electron microscopy. From the surviving fraction of nitrous acid inactivation experiments, minute plaque mutants were highly unstable. The finding that the entire virus particle is radiosensitive is at variance with other data. In the case of bacteriophage ϕX174, only 76% of the particle is radiosensitive. This may be related to the fact that ϕX174 consists of DNA, whereas μ_2 is composed of RNA. (BBB)

33841 INFLUENCE OF ROENTGEN RADIATIONS ON ERYTHROCYTIC AND HEPATIC ENZYME ACTIVITIES IN RATS. Sartori, S.; Coucourde, F.; Mainieri, L. (Universita, Pavia, Italy). Haematologica (Pavia), 48: 361-80 (1963). (In Italian)

The liver and erythrocyte activities of the following enzymes were determined in adult rats which received single 400-R, whole-body doses of 180-kv x rays: glucose-6-phosphate dehydrogenase (G-6-PDH), lactic dehydrogenase (LDH), malic dehydrogenase (MDH), and aldolase (ALD). Some rats had been protected by an intramuscular injection of 125 mg methylmethionine sulfone (MMS). The animals were sacrificed and enzyme activities assayed at 7 or 15 days postirradiation. G-6-PDH activity showed the most marked change in irradiated animals in liver; the activity rose 75% above normal 7 days postirradiation in MMS-treated rats and 20% above normal in irradiated controls. No significant changes in erythrocyte G-6-PDH activity occurred. LDH activity rose 15% in liver in MMS-treated irradiated rats and fell 20% in untreated irradiated animals at 7 days. At 15 days postirradiation, LDH activities in liver and red cells were below normal. Liver MDH activity rose 15% in MMS-treated, irradiated animals and 30% in irradiated rats, 7 days postirradiation; at 15 days both red cell and liver MDH activities were high. Red cell ALD activities fell 45% in MMS-treated, irradiated rats at 7 days; at 15 days ALD activities in both liver and red cells

were below normal in the irradiated groups. Although the results tended to be somewhat variable and show no definite trend, statistical analysis allowed some conclusions. Thus the postirradiation increase in liver and red cell G-6-PDH and the decrease in liver LDH and ALD activities in irradiated animals appeared to be significant. (BBB)

33842 THE ACTION OF X RADIATION ON SUGAR ABSORPTION. Hehl, R.; Wilbrandt, W. (Universitat, Bern). Helv. Physiol. Pharmacol. Acta, 22: 319-22(1964). (In German)

An earlier study of Zehnder (Radiol. Clin., 29: 127(1960)) on the effect of 800-R x irradiation of the rat on intestinal absorption of sugar showed that in vitro sugar absorption in isolated segments of intestine was depressed at one, six, and 48 hr but stimulated at 24 hr post-irradiation. Further studies were conducted to elucidate the nature of this biphasic response. Thus, as in the earlier experiments, the rate of glucose absorption in vitro from the jejunum of normal rats and of rats previously x irradiated (800 R) was measured. First a decrease of the absorption rate was found one hr after irradiation (phase I), and a second one 24 hr after irradiation (phase II). Phase I appeared to depend on irradiation of the adrenals; it was not seen after irradiation of the isolated intestine (in vivo) or in adrenalectomized animals. It is concluded that the adrenal-mediated effect is related to the recently reported link between sugar absorption and sodium transport. Thus there is an inhibition of sugar absorption in adrenalectomized animals. The mechanism of sugar absorption in the intestine is dependent upon the so-called sodium pump, and is inhibited in Na deficiency. The present results confirmed and explained the previous findings of Zehnder, except that stimulation of sugar absorption which he observed 24 hr postirradiation could not be confirmed. The second inhibitory phase, seen at 48-hr postirradiation in both studies, is attributed to the radioinduced injury to the cell regeneration process which normally provides for a rapid renewal of the cell population in the mucosa of the intestinal crypts. (BBB)

33843 RADIOBIOLOGICAL STUDIES IN PLANTS. IX. FURTHER STUDIES ON THE GROWTH INHIBITION BY RADIATIONS FROM THE NUCLEAR REACTOR, JRR-1. Nishiyama, Ichizo; Ichikawa, Sadao; Uematsu, Setsuko; Amano, Etsuo (Kyoto Univ., Japan). Ikushugaku Zasshi, 14: 69-74(1964).

Previous studies of the effects of radiations from the JRR-1 reactor on the inhibition of seed germination and seedling growth showed that when irradiation was carried out in the beam hole No. 16, 20 sec was enough to damage all seedlings completely when the reactor was operated at 40 kw. Thereafter beam hole No. 7 was used for biological research because of the low dose rate of radiation in this hole. Radiations from hole No. 7 probably consist of a higher percentage of thermal neutrons. Dry seeds of Triticum monococcum and Avena strigosa were sealed in a thin polyethylene bag holding them in a single layer for irradiation in holes 7 and 16. Results showed that growth inhibition generally increased with increasing radiation doses. Decrease in growth was greater in Triticum than in Avena. Some plants of Avena survived from the irradiation of 10×10^{12} n/cm^2 flux from hole No. 16, but none of the Triticum plants survived irradiation of 7×10^{12} n/cm^2. Such a tendency was also found in experiments with hole No. 7. The relation between the length of the first leaves and thermal neutron dose was linear. The results of experiments using hole No. 7 indicated that growth inhibition was more severe in the seedlings from seeds irradiated at the inner side of the double layer of seeds than those at the outer side. This phenomenon seems to be partly due to the difference in the distance (ca 4 mm) and partly to the absorption of radiations by the seeds on the inner side of the samples. There were marked differences between the biological effects of radiations from holes No. 7 and 16. Radiations of the hole No. 16 were much more effective than those of hole No. 7, that is, 4.0×10^{12} n/cm^2 in the hole No. 16 corresponded to 30.5×10^{12} n/cm^2 in hole No. 7 regarding biological effects. Thermal neutrons, fast neutrons, resonance neutrons, and γ rays probably were emitted in different ratios in the two holes. In hole No. 16, exposure for only 14 sec (7.0×10^{12} n/cm^2) caused the complete inhibition of seedling growth in Triticum, but in hole No. 7 even 28-hr/exposure (30.5×10^{12} n/cm^2) did not give complete inhibition. Therefore, the extremely high dose rate in hole No. 16 might explain this in terms of a dose-rate effect. (BBB)

33844 CHANGES IN LIVER FOLLOWING TOTAL BODY IRRADIATION IN ALBINO RATS. Agarwal, S. K.; Mehrotra, R. M. L. (King George's Medical Coll., Lucknow, India). Indian J. Med. Res., 52: 1073-9(1964).

Histopathological and biochemical changes in the liver of rats exposed to total-body radiation doses of 500, 1,000, and 3,000 R were studied. The livers of irradiated animals showed changes which consisted of nonlipid cytoplasmic vacuolation of the parenchymatous cells and occasional foci of necrosis. The biochemical changes in the irradiated animals consisted of increase in hepatic glycogen and wet weight of the liver, there being no significant alterations in the liver lipids, water and total nitrogen. It is suggested that the changes observed in the liver are due to general toxemic state produced by irradiation. (Excerpta Med.)

33845 INTRALYMPHATIC ISOTOPES FOR RADIATION OF NODE METASTASES. Burger, R. H.; Asano, M., Nagamatsu, G. R. (New York Medical Coll., New York). Invest. Urol., 2: 215-25(1964).

Intralymphatic radioactive isotopes have been used in human malignancies. An experimental animal system was designed to test the effectiveness of this method in radiating lymph nodes which drain a site of primary carcinoma. The Vx-2 rabbit carcinoma was prepared and injected into each gastrocnemius muscle of the animal. Later 500 μc of $Cr^{32}PO_4$ was injected into one afferent lymphatic leading to the popliteal node on one side using the opposite side as the untreated control. At varying times after isotope injection, rabbits were killed and both popliteal nodes were weighed, examined for gross and microscopic metastases, and radioautographed. All untreated (control) nodes grew abundant nests of tumor cells. All treated nodes showed marked radiation effect and were significantly smaller than the untreated nodes. Two out of nine treated nodes showed no viable tumor cells. The other seven showed very small areas of viable appearing tumor in the periphery and subcapsular areas only. This form of intranodal radiation is highly effective in destroying most, but not all metastatic cells from an untreated primary experimental cancer. (Excerpta Med.)

33846 TUBERCULOSIS, MALIGNANT DISEASE OF THE RETICULOENDOTHELIAL SYSTEM, AND RADIATION IN HIROSHIMA. J. Am. Med. Assoc., 192: 713(May 24, 1965).

Brief comment is made on the recent findings of the Atomic Bomb Casualty Commission in Hiroshima of the increased incidence of tuberculosis in Japanese with myelofibrosis and chronic myeloid leukemia, especially among survivors of the atomic bombing who were within 1400 m of the hypocenter. (BBB)

33847 ACUTE LEUKEMIA IN INFANCY AND CHILDHOOD. Kline, Charles A. J. Am. Osteopath. Assoc., 64: 266-79(Nov. 1964).

The etiology of leukemia, including radiation, as well as the symptoms, diagnosis, and treatment of leukemia are reviewed. (BBB)

33848 THE RESISTANCE OF SPORES OF CLOSTRIDIUM BOTULINUM TYPE E TO HEAT AND RADIATION. Roberts, T. A.; Ingram, M. (Low Temperature Research Station, Cambridge, Eng.). J. Appl. Bacteriol., 28: 125-38(Apr. 1965).

Spores were screened for resistance to heating in aqueous suspension at 60, 70, and 80°C. Decimal reduction times at 176°F (D^{176}) ranged from <0.33 min to 1.25 min; z values of eight strains were between 9.0 and 10.7, and for one strain was 7.4. Survivor curves after ^{60}Co γ irradiation at a dose rate of 1.83×10^5 Rad/hr were plotted for nine strains, and a further nine strains were screened. The shoulder extends to about 0.4 MRad, whereafter the curve

becomes exponential within a D value from 0.065 to 0.16 MRad. Graphs of log percent survivors against γ-radiation dose are presented, and D values (decimal reduction factors) compared with those published previously. The percentage survival of 17 strains of C. botulinum type E after irradiation in aqueous suspension is also shown. Most resistant of the Pacific strains was Alaska ($D_{(exponential)}$, 0.13 MRad) and of the Scandinavian strains, 16/63 ($D_{(exponential)}$, 0.20 MRad in water, 0.22 MRad in broth). The resistance of 16/63 and 1957/61 was greater if spores were obtained from media C3, G1, and L1 than from A1 (compositions of these media are shown). On the other hand the resistance of spores of 4318/63 was not increased in these media. Medium H1 caused an increase in the resistance of 1957/61, but not of 16/63. This variation in resistance must depend on both the main components of the medium since for 16/63 the resistance varies L1 > G1 > A1 = B1 > C1 and C3 > C2 > C1. The irradiation of a broth suspension of vegetative cells and spores of strain 1304E resulted in a broken survivor curve with an exponential inactivation of vegetative cells (D value, 01. MRad) ending before the beginning of the exponential inactivation of the spores (D value in broth, 0.15 MRad). (TCO)

33849 THE RESISTANCE OF CLOSTRIDIUM BOTULINUM TYPE E TOXIN TO RADIATION. Skulberg, A. (Veterinary College of Norway, Oslo). J. Appl. Bacteriol., 28: 139-41(Apr. 1965).

Clostridium botulinum type E 1537/62 was grown in Robertson's cooked meat medium at 25°C for 6 days, and the cells were removed by centrifugation. Samples of supernatant fluids or of cell suspensions were packed in polyethylene pouches, which were maintained at 0°C in ice water prior to irradiation. They were irradiated on solid ice and returned to ice water immediately after irradiation. A 2-Mev Van de Graaff generator was used, adjusted to give a dose of 1 MRad to a theoretical depth of 7 mm/passage under the electron beam. The toxicity of the supernatant fluid declined with the radiation dose; the toxicity values (MLD/ml) were 6.4×10^3, 1.6×10^3, 1.6×10^3, 100, 50, and <1 after doses of 0, 1, 2, 4, 6, and 8 MRad, respectively. The observed radiation resistance of the type E toxin was of a similar order to that recorded earlier for type A toxin. It is evident that the radiation resistances of these toxins vary greatly from one preparation to another, owing perhaps merely to differences in degree of polymerization of the toxin molecule. Until this variation can be better controlled, no strict comparison between different types of toxin is possible. It was concluded that type E toxin, like that of types A and B, is so resistant to ionizing radiation that practical doses of radiation (of the order <5 MRad) cannot be relied upon to destroy it. (BBB)

33850 PHOTOREVERSIBLE ULTRAVIOLET ENHANCEMENT OF INFECTIVITY IN AGROBACTERIUM TUMEFACIENS. Heberlein, Gary T.; Lippincott, James A. (Northwestern Univ., Evanston, Ill.). J. Bacteriol., 89: 1511-14(June 1965).

Irradiation of a virulent strain of Agrobacterium tumefaciens with short-wavelength ultraviolet light, which reduces viability 50 to 90%, increases its infectivity as measured by the number of lesions initiated per viable bacterial cell on primary pinto bean leaves. A dark treatment of 1.5 to 2 hr between irradiation and inoculation results in a further increase in specific infectivity of as much as fourfold. This increase in infectivity is inhibited by white fluorescent light and light of 402 mμ, but only slightly by 549- or 619-mμ light. These results imply that some change in the deoxyribonucleic acid of the bacterium is responsible for this effect. (auth)

33851 GENETIC FACTORS IN RADIATION RESISTANCE OF BACILLUS SUBTILIS. Zamenhof, Stephen; Bursztyn, Hela; Reddy, T. K. Ramachandra; Zamenhof, Patrice J. (Columbia Univ., New York and Univ. of California, Los Angeles). J. Bacteriol., 90: 108-15 (July 1965).

A study of several wild cross-transformable strains of Bacillus subtilis revealed differences in the resistance of their spores to x rays. Closer study of two such strains revealed differences of the same type when vegetative cells were exposed to x rays or to ultraviolet light (uv). Cell cultures repeatedly exposed to sublethal doses of uv (when cultivation between exposures) became more resistant to uv, presumably by enrichment in a more uv-resistant mutant. A sulfanilamide-resistant mutant of one strain (vegetative cells and spores) was less resistant to ionizing radiation; this sensitivity was transferable by transformation. No difference in radiation-induced mutability could be demonstrated in any of the strains studied. It is concluded that, at least in the cases studied, the differences in radiation resistance of spores of different strains are not just a result of a superimposition of a common spore resistance mechanism(s), but rather are an amplification of genetically determined resistance differences in vegetative cells of these strains; sulfanilamide-resistance locus (p-aminobenzoic acid overproduction locus) is one of the loci of radiation sensitivity; no evidence was obtained that the differences in radiation resistance of cells or spores can be ascribed to differences in radiation resistance of their deoxyribonucleic acid. (auth)

33852 GROWTH AND DIVISION OF FILAMENTOUS FORMS OF ESCHERICHIA COLI. Adler, Howard I.; Hardigree, Alice A. (Oak Ridge National Lab., Tenn.). J. Bacteriol., 90: 223-6(July 1965). (ORNL-P-972)

Cells of certain mutant strains of Escherichia coli grow into long multinucleate filaments after exposure to x radiation. Deoxyribonucleic acid, ribonucleic acid, and protein synthesis proceed, but cytokinesis does not occur. Cytokinesis (cross-septation) can be initiated by exposure of the filaments to pantoyl lactone or a temperature of 42 C. If growing filaments are treated with mitomycin C, nuclear division does not occur, and nuclear material is confined to the central region of the filament. Cytokinesis cannot be induced in mitomycin C-treated filaments by pantoyl lactone or treatment at 42 C. (auth)

33853 CONGENITAL MALFORMATIONS AND BACKGROUND RADIATION IN NORTHERN NEW ENGLAND. Segall, Ascher; MacMahan, Brian; Hannigan, Mary (Harvard Univ., Boston). J. Chronic Diseases, 17: 915-32 (Oct. 1964).

Inhabited areas of relatively low or high terrestrial radioactivity in Maine, New Hampshire, and Vermont were delineated on the basis of radiogeological criteria. Dosimetric surveys were conducted in these areas to estimate differences in population exposure to external and internal radiation of natural origin. The rate of congenital malformations in the two areas, and of infant deaths and fetal deaths, was determined on the basis of hospital and civil records. The weekly dose rate from external γ emitters received by 50 persons in each of the eight radiogeological categories was monitored over a period of 5 weeks, using a personnel dosimeter, and the equivalent U concentration of the local soil was estimated by γ spectroscopy. Geographic variation in exposure to natural internal emitters was examined by determining ^{226}Ra and ^{210}Po in teeth of long-time residents. The level of ^{226}Ra in pooled samples of tap water was also measured. The equivalent U concentration of unconsolidated material and soil shows a significant correlation with that of the underlying bedrock. However, the range of values for soil (8.8 to 16.5 ppM) is considerably narrower than is the range for the corresponding geological formations (5 to 45 ppM). The extent of geographic variability in the levels of human exposure to terrestrial radiation is more closely related to the concentration of γ-emitting radioisotopes in the upper layers of the soil than it is to bedrock radioactivity. The mean weekly dose rate from terrestrial γ radiation, as measured by personnel dosimetry, varies from 2.38 mR/week in towns overlying the Monkton formation in Vermont to 3.22 mR/week in towns located over Conway granite in New Hampshire, representing a maximum difference of 35%. Estimated dose of cosmic radiation varied from 0.63 to 0.71 mR/week, exclusive of the cosmic neutron dose. The estimated mean annual dose to bone tissue from ^{226}Ra ranged from 0.68 to 1.81 mrad. The concentration of ^{226}Ra in samples of tap water varied from 0.01 to 0.08 μC/l

but showed no significant correlation with bedrock radioactivity. Values for the estimated mean annual dose to bone tissue from ^{210}Po ranged from 3.15 to 4.14 mrad. Differences between individuals with this radioisotope were more marked than with ^{226}Ra. A table shows the mean annual population dose rates from those external and internal sources of natural radioactivity subject to geographic variability in the two study areas. It is concluded that no evidence was found for a hypothesis linking the teratogenic effect of natural radioactivity to any individual category of malformations. Natural radioisotopes gave an inter-areal difference of ~10% (13 mR/hr) in the mean population dose rates from background external γ emitters, but no significant variation in the dose rates from internal α emitters ^{226}Ra and ^{210}Po. No evidence of consistently elevated rates for malformations or of a consistent increase in risk with respect to any individual category of malformations was found in births to residents of the high bedrock radioactivity area. (BBB)

33854 AN EPIDEMIOLOGICAL STUDY OF CHILDHOOD LEUKEMIA. Ager, Ernest A. (Washington State Dept. of Health, Olympia); Schuman, Leonard M.; Wallace, Helen M.; Rosenfield, A. B.; Gullen, Warren H. J. Chronic Diseases, 18: 113-32(Feb. 1965).

This childhood leukemia study, initiated in 1958, had two main objectives: (1) to determine whether an association exists between exposure to ionizing radiation and development of leukemia; and (2) to evaluate the relation of certain other environmental and host factors to childhood leukemia. The data consist of interview information verified by inspection of medical records. The population studied consisted of Minnesota residents in the 0- to 4-yr age group who died of leukemia during the five-yr period 1953 to 1957. The study included 112 cases of childhood leukemia with matched sibling and neighborhood control subjects. Maternal age at time of birth of the leukemia patients was more than two years greater than maternal age at the time of birth controls. Birth order averaged 0.46 births later in leukemia patients than in control children. Mongolism was encountered in eight leukemia cases, in no sibling control subjects, and in one neighborhood control subject. The frequency of association of leukemia and mongolism in this series is significantly greater than has been reported previously. A verified history of antenatal x-ray exposure was more common among the leukemia patients aged 0 to 4 yr than in either control group. However, the excesses of total x-ray exposure in pregnancy of mothers of leukemia patients over that for the pregnancies with the sibling control subjects (2.8%) and that for the pregnancies with the neighborhood control subjects (1.8%) were not statistically significant. The rates of exposure were 33.9% for leukemia patients, 26.7% for sibling controls, and 27.7% for neighborhood controls. Twenty of 112 (17.9%) of leukemia patients were exposed to x rays in utero, as compared with 16 of 105 (15.2%) of sibling controls and 16 of 112 (14.3%) neighborhood controls, but these differences were not statistically significant. In an attempt to assess the magnitude of association of x-ray exposure of the child and the subsequent development of leukemia, a distinction was made between: (1) x-ray exposures occurring during diagnostic procedures for illnesses that ultimately proved to be leukemia, and (2) x-ray exposures which occurred before the onset of the disease process. Leukemia cases revealed that frequently many x rays had been made before the diagnosis was established, and frequently also, x rays were made during the course of the illness, as intercurrent respiratory infections and gastrointestinal symptoms occurred. Data revealed that 22 of 112 (19.6%) leukemia patients, 17 of 105 (16.2%) sibling control children, and 20 of 112 (17.9%) neighborhood control children incurred x-ray exposure during early childhood, but the differences between the leukemia patients and matched control subjects were not statistically significant. When the taking of four or more x-ray films, fluoroscopy, or deep therapy were arbitrarily classed as heavy x-ray exposures, 18 children (of the 329 studied) could be placed in such a category. Of these, 9 were leukemia patients, 5 were sibling controls, and 4 were neighborhood controls. Two of the 9 leukemia patients and one of the neighborhood control children received deep x-ray therapy for thymic enlargement in infancy. Since the various test computations yielded nonsignificant results, the power function for the most disparate difference observed (antepartum abdomino-pelvic x-ray exposure—leukemic cases vs neighborhood controls) was constructed to evaluate the sensitivity of the study in recognizing a difference, if there existed such a difference. These results indicated that if antepartum x-ray exposure of leukemic exceeded that of nonleukemic children in the population of 0- to 4-yr-olds by 5.0%, the probability that this investigation (with the sample sizes utilized) would have detected the existence of any difference is only about one in three. Even if a true excess of 10% existed, the probability that the existence of any difference would not have been detected is approximately 25%. Therefore, neither the presence nor the absence of a difference was demonstrated in this study. Data collected on chemical exposures and usage of drugs were not considered sufficiently reliable to warrant detailed analysis. (BBB)

33855 IMMUNE MECHANISMS IN PARABIOSIS INTOXICATION. Hilgard, Henry R.; Cornelius, Eugene A.; Dalmasso, Agustin P.; Martinez, Carlos; Good, Robert A. (Univ. of Minnesota, Minneapolis). J. Exptl. Med., 119: 567-79(Apr. 1, 1964).

When A strain mice are placed in parabiotic union with (A X C57B1/1)F_1 hybrid partners, the parental strain partners are polycythemic and the hybirds anemic from the 5th through the 16th parabiosis days. All hybrids develop clinical intoxication between the 7th and the 12th days, and no pairs survive to one month. Long-term survival of parabiotic pairs was achieved if lethally irradiated or specifically tolerant parental strain mice are united to hybrid partners. Thus mice of the A strain were rendered specifically tolerant to (A X C57B1/1)F_1 hybrid antigens by submitting them to total-body x irradiation in a dose of 600 R in air followed immediately by an intravenous infusion of 200 million F_1 hybrid spleen cells. Two weeks later these mice received (A X C57B1/1)F_1 hybrid skin grafts. They were used for parabiosis 4 weeks after grafting if the grafts had been fully accepted. A lethal dose of x irradiation was used because it has been shown that irradiation severely depresses graft vs host reactions and the capacity to form antibody. The irradiated parental strain mice were polycythemic and their hybrid partners anemic on the 5th days, but this hematocrit difference was eliminated by the 12th day after the union. The course of anemia-polycythemia was strikingly similar to that seen in the syngeneic pairs which had shown a hematocrit difference on day 5. Eight of the original 21 pairs had died by the 16th day, and it was often observed that the parental strain partner was the first member to succumb, most probably as a result of the lethal x irradiation received prior to union. Eleven pairs were alive one month after parabiosis, and ten of these survived two months or more. The protective effect which parabiosis confers upon lethally irradiated animals has been previously reported and may be the result of the passage of lymphoreticular cells from the nonirradiated parabiont into the irradiated partner. None of the F_1 hybrids united to irradiated parental strain partners showed clinical signs of intoxication. The absence of hybrid intoxication and the elimination of anemia-polycythemia by the 12th day was presumably the result of the establishment of a specifically tolerant state in the irradiated parental strain mice toward their F_1 hybrid partners. Preimmunization of the parental strain partners against the C57B1/1 component of the hybrid leads to a considerable intensification of day 5 anemia-polycythemia. Intoxication develops in the hybrid partners between the 4th and the 6th days after union. It is concluded that anemia is primarily responsible for the syndrome of clinical intoxication. Early anemia-polycythemia on day 5 does not depend upon an immunological mechanism, but the late anemia-polycythemia appearing between days 12 and 16 is a function of the ability of the parental strain mouse to react immunologically against its hybrid partner. When neonatally thymectomized A strain mice are joined to hybrid partners, anemia-polycythemia is sustained through

the 16th day and the hybrid partners develop clinical intoxication. On the other hand, when both partners are neonatally thymectomized, late anemia-polycythemia is considerably reduced, and the hybrid partners apparently do not develop clinical intoxication. It is concluded that normal hybrid mice are capable of reconstituting the immunological capacity of their thymectomized partners, whereas thymectomized hybrid mice do not have this restorative capacity. (BBB)

33856 THE QUANTITATIVE INTERRELATIONSHIPS BETWEEN ION FLUXES, CELL SWELLING, AND RADIATION DOSE IN ULTRAVIOLET HEMOLYSIS. Cook, John S. (New York Univ., New York). J. Gen. Physiol., 48: 719-34 (Mar. 1965).

Ion and water fluxes through human erythrocyte membranes were studied following exposure of the cells to uv radiation as a lytic agent. The principal objective was to examine quantitatively the hypothesis of colloid osmotic hemolysis, which mechanism is thought to underlie the action of a number of hemolytic agents, including uv radiation. Sodium-24 and ^{42}K were used to follow ion fluxes in the cells. Following treatment with uv radiation, human red cells leak cations at accelerated rates which depend on the radiation dose. With one exception (initial Na efflux), these accelerated cation fluxes fit the Ussing flux-ratio criterion for passive diffusion. The Na efflux is transiently high, but with time falls to the value expected on the basis of the other cation fluxes. An equation based on the hypothesis of colloid osmotic hemolysis satisfactorily predicts the rate of cell swelling as a result of these ion movements. The hypothesis of colloid osmotic hemolysis states that the injury to the cell permits passive ion movements more rapid than can be handled by the active transport systems. Under the driving force of both concentration and electrical potential gradients, salts and water diffuse isosmotically across the red cell membrane. (BBB)

33857 RADIATION EFFECTS ON RESPONSE TO INACCESSIBLE FOOD. McDowell, A. A.; Brown, W. Lynn (Univ. of Texas, Austin). J. Genet. Psychol., 106: 85-8 (1965).

Previously it was proposed that the observed decreased distractibility of the irradiated monkey results in relatively more of his responses per standard unit of time being directed toward food and toward those cues spatially contiguous with food than in the case of the normal monkey. This was supported by a study showing facilitated responsiveness to food by naive irradiated monkeys in the WGTA (Wisconsin General Test Apparatus) and in another study showing less disruption of response latencies for irradiated than control monkeys when a novel nonrewarded stimulus block was added to a WGTA test condition. The present study attempted to test this hypothesis directly by comparing the responses of normal and previously irradiated adult male monkeys to visually accessible but physically inaccessible food. Of the 11 rhesus monkeys tested, aged six to eight yr, five had been exposed to chronic fast-neutron radiation more than four yr earlier, when they had been given a 24-hr whole-body exposure every four days at 87.2 mrep/hr until a total dose of 583 rep was achieved. The six controls had been sham-exposed. A special Plexiglas apparatus was used for testing responsiveness to visible but inaccessible food. Over a three-day period, each monkey was first observed with the empty food holder present in the cage, next with the food holder present and filled with diced apple and orange slices, and again with the empty food holder present. The presence of food produced a marked increase in responses to the food holder by irradiated monkeys, but only a slight increase in similar responses for controls. It is concluded that these results are in direct support of the hypothesis of greater responsiveness to food for irradiated than for control monkeys. On the average, the responsiveness of the irradiated animals to inaccessible food was almost three times that of controls. Such results may reflect increased hunger drive accruing to radiation exposure, a radiation-induced elevation in response-threshold values with consequent greater attention to prepotent stimuli, or some other factor(s). (BBB)

33858 X-IRRADIATION OF PUPAE OF THE HOUSE FLY, MUSCA DOMESTICA L., AND MALE SURVIVAL. Dauer, Maxwell; Bhatnagar, Prem Lata; Rockstein, Morris (Univ. of Miami, Coral Gables, Fla.). J. Gerontol., 20: 219-23(Apr. 1965).

Effects of varying dosages of x irradiation administered to young pupae upon the survival of the adult male house fly were evaluated. Pupae were exposed to a single dose of x rays which varied from 10,000 to 30,000 rad (at 250 kvp). Irradiation to 10,000 rad increased mean survival over untreated normally emerging males by about 2.8 days. Survival of the irradiated flies was significantly higher than the normal beginning at about eight and up to about 30 days after emergence. These differences disappear thereafter, so that the maximum longevity of the flies of 43 days was not altered by prior irradiation. After 15,000 rad the initial rate of mortality of the treated and control flies was similar, but only up to the 10th day after emergence, after which the survival curve once again showed a shift toward the right of the control curve, representing an increase in the average life span of 3.4 days, (highly significant in comparison to the untreated males). Similar results in males exposed to 15,000 rad as pupae were seen. In spite of a slightly higher initial rate of mortality immediately after emergence, flies which emerged from pupae previously exposed to 20,000 rad did not show a significant difference in average survival time (13 days) from the normally aging males. After the 15th day, the rate of mortality of males treated as pupae with 20,000 rad was much higher than that of the untreated ones. However, at 30,000 rad, the entire survivor curve shifted significantly to the left of the control: 50% of the males died within 10 days, and 100% mortality occurred by the 19th day after emergence; mean life span was 10 days compared with 13.2 in normal flies. Wing loss, seen in normal aging flies, was also present in the males treated with x rays, but only at dose levels of 20,000 rad or below. Male flies emerging from the pupae irradiated at 30,000 rad did not show significant loss of wings as late as the 19th day after emergence. This suggests that the radioresistance, survival, and failure of the flight mechanism of the male house flies may not depend only upon the sets of chromosomes, but also on the presence (or absence) of certain genes. The longevity of male house flies treated as pupae with x rays may then be the result of injury or destruction of cells, the future development of which cells is determined by such sex-linked characters. Thus x irradiation not only hastens aging in some animals, but also may eliminate, antagonize, or minimize the action of factors normally responsible for aging in others (like the male house flies). (BBB)

33859 IMMUNOLOGIC UNRESPONSIVENESS TO HETEROLOGOUS SERUM PROTEINS INDUCED IN ADULT MICE AND TRANSFER OF THE UNRESPONSIVE STATE. Dietrich, Felix M.; Weigle, William O. (Scripps Clinic and Research Foundation, La Jolla, Calif.). J. Immunol., 92: 167-72(Feb. 1964).

These experiments were designed to study the properties of the tolerant state induced in irradiated adult mice to serum protein antigens and to compare the tolerance induced in adult mice with tolerance induced in neonatal mice. Also, the rates of catabolism of serum protein antigens in mice were compared with the dose of antigen needed to establish tolerance in the adult to the same antigen. In the induction of immunologic unresponsiveness newborn C57B16 mice were injected subcutaneously with 20 mg of human γ-globulin (HGG) which induced a specific tolerant state lasting at least 12 weeks. Spleen cells were obtained from 8-week-old mice made tolerant after birth and from mice of the same age injected with 1 mg of HGG 2 weeks earlier and homogeneous cell suspensions were prepared, and injected intravenously into lethally irradiated mice given 25 units of heparin before the transfer. Recipients of spleen cells were given 825 R of x rays 2 to 4 hr before the cell transfer. This dosage was shown to be an $LD_{90/15}$ for mice not protected by an injection of spleen cells. Irradiated

mice were given drinking water containing oxytetracycline; omitting the antibiotic considerably shortened the surviving time of unprotected; irradiated mice. Lethally irradiated recipients were injected with neonatal tolerant spleen (NTS), adult tolerant spleen (ATS), or adult normal spleen cells (ANS). Six days later, the animals were challenged with 0.1 mg of HGG. In preliminary experiments suitable radiation doses, and amounts of spleen cells necessary to protect irradiated mice, were determined. Doses of 800 to 900 R whole-body irradiation were found to have a lethal effect in 90 to 100% of the mice within 2 weeks ($LD_{90/15}$ to $LD_{100/15}$). One hundred, 75, 50, and 25×10^6 isologous ANS cells given intravenously 2 to 4 hr after irradiation protected the mice from radiation damage in that the mice survived for the duration of the experiment. However, 100×10^6 ANS cells given intraperitoneally had no protective effect. Although 75 to 100×10^6 ANS cells completely restored the immunologic capacity of lethally irradiated hosts, the injection of the same number of either NTS or ATS cells did not result in a measurable antibody response to a subsequent injection of HGG in incomplete adjuvant. The unresponsiveness was specific in that irradiated mice injected with either NTS or ATS cells made an antibody response to a subsequent injection of another antigen incorporated into incomplete Freund's adjuvant. The unresponsiveness to HGG was sometimes short and some mice gradually lost their tolerant state as evidenced by an immune elimination, beginning 3 to 4 days following injection of HGG. NTS cells were superior to ATS cells in maintaining their tolerant state when transferred to irradiated recipients. The results demonstrate that adoptive tolerance is a general phenomenon which can be obtained by transferring both NTS and ATS cells. Thus, the mechanisms involved in the induction of tolerance either early after birth or later in adult life may be similar. Adoptive tolerance by transfer of NTS and ATS cells, however, did not seem to be of long duration. The loss of the tolerant state by the recipients could be the result of the loss of the tolerant state of the transferred cells, recovery of the host's own immunologic apparatus, or both. (BBB)

33860 THE EFFECT OF GAMMA IRRADIATION ON THE HEMOCYTE COUNTS OF LARVAE OF THE POTATO TUBERWORM, GNORIMOSCHEMA OPERCULELLA (ZELLER). Elbadry, Esam (Univ. of Ain Shams, Shubra, U.A.R.). J. Insect Patho., 6: 327-30(Sept. 1964).

The effect of ^{60}Co γ irradiation on total hemocyte counts (THC) and differential hemocyte counts of larvae in three instars of the potato tuberworm was evaluated. Irradiation with 3000 and 9000 rad had a noticeable effect on the total hemocyte counts. The THC decreased in treated larvae, regardless of whether they were subjected to irradiation at an early stage of development or at an advanced stage. By comparing the three larval instars that had been subjected to 3000 or 9000 rad, it was clear that the third instar was less affected as to the reduction of THC, which indicate that the third-instar larva is more resistant than earlier instars to the effect of irradiation on blood cells. However, statistical analysis revealed no significant difference between THC of larvae of the same age treated with 3000 and 9000 rad. The THC of insects vary greatly with technique, species, stage of development, various physiological states within a stage, and many other factors. For example, in some cases, the THC increase briefly with bacterial infections but in others may show no change or may even decrease. The THC may be greatly affected by the nutritional state, and this might be an explanation for the decrease of THC or irradiated tuberworm larvae. Irradiated larvae were of smaller sizes and lighter weight than nonirradiated controls. Also studied was the effect of γ rays in the differential hemocyte count. Three cell types were recognized, namely, plasmatocytes, adipohemocytes, and spheroid cells. In untreated insects, the plasmatocytes were found to constitute about one-third of the total blood cells. No conclusions could be drawn from the results obtained, except that the blood picture is not significantly changed by irradiation. Some morphological changes in the plasmatocytes were observed. Small numbers of plasmatocytes had an elongated shape with slightly larger nuclei. (BBB)

33861 EFFECT OF X-IRRADIATION UPON THE INFECTIVE LARVAE OF ANCYLOSTOMA CANINUM AND THE IMMUNOGENIC EFFECT IN DOGS OF A SINGLE INFECTION WITH 40 kR-IRRADIATED LARVAE. Miller, T. A. (Glasgow Univ.). J. Parasitol., 50: 735-42(Dec. 1964).

The effects of x irradiation on the parasite were studied in an attempt to immunize dogs by a single vaccination regime using such irradiated larvae. Irradiation of the infective larvae of A. caninum reduced the infectivity of the larvae as measured by subsequent intestinal establishment of adult hookworms. As the dose of radiation was increased the infectivity of the larvae decreased and the pathogenicity to the host of the resulting burden of hookworms was reduced. Male larvae were more sensitive to the effects of x irradiation than female larvae, particularly at the higher levels of irradiation. At radiation doses of 40 kR and greater the female worms in the resulting population were invariably sterile. A single subcutaneous vaccination of dogs age 3 months with 1000 40-kR-irradiated larvae conferred a highly significant resistance. This vaccination conferred highly satisfactory resistance to the pathogenic effects of such a challenge, when measured in terms of hematological, clinical, and coprological changes. The resistance of vaccinated dogs was exhibited in two separate actions. First, the resistance inhibits challenge hookworm establishment and reduces the egg production of the small challenge burden which does mature. Second, the resistance reduces blood loss to less than that which one would expect from the size of the challenge worm burden. Some blood loss which was seen during vaccination may result in a more active hemopoietic system in the vaccinates and therefore a more rapid and effective response to blood loss could be expected during challenge. Earlier work using the European dog hookworm showed that Uncinaria stenocephala was similarly susceptible to x irradiation with a similar reduction in worm establishment at irradiation doses of 20 and 40 kR, although the sterilizing effect of 40-kR irradiation was not recorded previously. (BBB)

33862 ACUTE TOXICITY OF RADIATION-STERILIZED PROPYLENE GLYCOL. Hickman, J. R. (United Kingdom Atomic Energy Energy Authority, Wantage, Berks, Eng.). J. Pharm. Pharmacol., 17: 255-6(Apr. 1965).

This investigation was stimulated by the need to sterilize a solution of diisopropylfluorophosphonate (DFP) in propylene glycol (1 mg/ml). The DFP was prepared with labeled phosphorus (^{32}P) and the solution was intended for parenteral use in clinical studies of blood cell turnover. Preliminary studies indicated that the potency of the DFP itself was only very slightly affected by radiation sterilization, but no information was available on the effect of radiation sterilization on the toxicity of propylene glycol. A sample of redistilled propylene glycol was γ irradiated with 2.5 Mrad, the dose used for sterilization of medical equipment. Adult SPF rats were given either irradiated or unirradiated propylene glycol by intraperitoneal injection at the following doses: 9.4, 11.1, 13.0, 15.3, 18.0, and 21.1 ml/kg body weight. The LD_{50} values, calculated from the mortality after 5 days, with 95% fiducial limits were for the irradiated material 13.7 (12.5 to 15.1) and for the control material 14.2 (12.4 to 16.1 ml/kg weight; differences between groups were not significant. Irradiated or unirradiated propylene glycol was also given to mice (C3H strain) by intraperitoneal injection to a dose of 5 ml/kg weight. Before injection, 1 part of propylene glycol was diluted with 2 parts of normal saline. This dose is about half the median lethal dose in mice, but although all mice showed signs of intoxication (lack of coordination of movements followed by deep narcosis and, in a few cases, convulsions), no mice died within 7 days of injection. One week after injection with propylene glycol no differences were observed in general health, weight changes, or food and water intake between the groups receiving irradiated or unirradiated ma-

terial. Thus sterilization of propylene glycol with a dose of 2.5 Mrad of γ radiation does not increase its acute toxicity and this information may be of interest in relation to radiation sterilization of other pharmaceutical preparations formulated with propylene glycol. (BBB)

33863 EFFECT OF HEAD IRRADIATION WITH X RAYS ON CHOLESTEROL SIDE-CHAIN CLEAVAGE ACTIVITY IN RAT TESTES. Matsuba, Michio (Jikei Univ. School of Medicine, Tokyo); Shogo Ichii; Kobayashi, Shigeru. Jikeikai Med. J., 11: 97-9(July 1964).

Four groups of adult male rats of the Wistar strain were studied, each group consisting of 6 animals. The animals were placed in a special lead-shielded holder so that only the head was exposed to x irradiation at a rate of 150 R/min. Four animals of each group were irradiated with 3000 R, and the remaining two animals were placed in the lead-shielded holder without irradiation for the sham-irradiated controls. The animals were sacrificed at 6 hr (1st group, 24 hr (2nd group), 48 hr (3rd group), and 72 hr (4th group) postirradiation. The left testes were quickly removed, weighed, and homogenized with 12 volumes of ice-cold 0.154M KCl solution. Incubations were carried out with 400,000 cpm of cholesterol-26-^{14}C (with a sp act. of 14 μC per μmole) in 0.01 ml of propylene glycol, with determination of radioactivity of isocaproic acid liberated during incubation. The activities of cholesterol side-chain cleavage were expressed as the radioactivities (cpm per 100 mg testicular tissues and cpm per left whole testis) of isocaproic acid liberated during two hours incubation with testicular homogenates. The activities of cholesterol side-chain cleavage in testes increased significantly at 6 hr postirradiation (to 1136 cpm), decreased to minimum (490 cpm) between 1 and 2 days postirradiation, and increased again (859 cpm) above the control values (739 cpm) at 3 days postirradiation. No decrease of body weight and testicular size was observed at least for 3 days postirradiation. The formation of 20α-hydroxycholesterol might be the rate limiting step of androgen production in testis, and gonadotropins of the anterior pituitary may act on this limiting step to accelerate cholesterol side-chain cleavage. These results suggest that release and/or production of pituitary gonadotropins might be increased at 6 hr after head irradiation, decreased between 24 to 48 hr postirradiation, and increased again by 72 hr postirradiation. (BBB)

33864 EFFECT OF pH AND IONIZING RADIATION ON THE ELECTROPHORETIC MOBILITY OF ESCHERICHIA COLI. Gaffney, Peter E. (Georgia Inst. of Tech., Atlanta). Life Sci., 4: 351-9(Feb. 1965).

Agar-grown, 48-hr cultures of E. coli were suspended in pH 7.4 phosphate buffer and exposed to 140-kv x rays to doses up to 145 kR or ^{137}Cs γ rays to 1.17 Mrad. In other samples, pH was varied from 1.1 to 10.6. The bacterial cells had the highest mobility and zeta potential in the near neutral environment; the potential and mobility were significantly reduced in an acidic environment (closer to isoelectric point of the cell) so that at pH 1.1 the particles had essentially no charge when the applied current was 5.0 ma. By comparing the data on the irradiated samples with the average control value, it was seen that (a) in the range of 10 to 100 R, most samples had higher mobility, (b) in the range of 2000 to 145,000 R, the samples had mobilities close to the control values, and in the dose range of 145,000 to over 1 million rad, mobility was significantly decreased, indicating a partial neutralization of surface charge. When plotted, the data show that a max limiting dose was reached (~300,000 rad) above which no further significant reduction of electrophoretic mobility occurred. Attempts were made to explain the mechanism by which mobility is reduced as a result of irradiation, and why there was no further reduction of mobility (surface charge) after exposures between 467,000 rad and 1.17 Mrad. If the effect of irradiation was metabolic, then an altered biochemical sequence may have directly effected a reduction in surface charge, and if it is assumed that the stability of this change in mobility were a function of the time necessary for recovery, dose rate would be an important factor. Thus, recovery may have occurred during the time required to expose the cells to doses above 467,000 rad (20 min). However, with ~ the same total dose under either x ray or ^{137}Cs, the resultant mobility values were identical, although the exposure time was 363 and 6.2 min, respectively. Since the organisms were suspended in an inorganic buffer at a temperature below optimum, the intensity of biochemical recovery would be limited. The effect of the time lapse between a single radiation dose (200,000 rad) and mobility measurement on the resultant mobility values was studied. Cesium-137 exposure of identical suspensions was ~9 min and electrophoretic determinations were made on the suspensions at various times ranging from 0.5 to 100 hr afterwards. The results showed that all values were in the expected range and there was no trend indicating biochemical recovery. Destabilization of sols (reduction of charge) may be due to radiochemically induced oxidation-reduction reactions at the particle surface. If irradiation contributes protons or oxidants in the aqueous phase which reduce the charge at the particle surface, the observed limiting dose-mobility reduction phenomenon may be a function of some limiting oxidizable (-SH, -NH_2, etc.) sites on the bacterial surface. This may explain the reason for a plateau at 300,000 rad. (BBB)

33865 OCCUPATIONAL RADIODERMATITIS OF THE HANDS. Lagrot, F. (Universitaire, Toulouse, France); Coriat, P. Lyon Chir., 60: 743-4(Sept. 1964). (In French).

The most dangerous circumstances for surgeons are fracture reductions, extractions of foreign bodies, and bone setting during exposure to irradiations; or any of the radiological examinations (angiography, cholangiography, hysterography, splenoportography, etc.). Use of the opaque agents under fluoroscopy can also be dangerous. Surgeons hands are sensitized by frequent washings, brushings, repeated cleansings with antiseptics, and irritation from the talc and rubber of gloves. Also surgeons, in their concentration on their work, may lose track of time and receive enormous doses. Radiolesions of surgeons are generally found on both hands, but tend to predominate on the left hand. They appear particularly on the dorsal face of the second and third phalanges of the second, third, and fourth fingers. The initial lesions of chronic radiodermatitis are: ungual alterations, keratosis, cutaneous atrophy, and telangiectases, followed by cracks and ulcerations. At a more advanced stage, the extensor tendons are destroyed and the phalanges become sequestrated. The final stage is neoplasic degeneration. Radiodermatitis is effectively treated by grafting and prolonged mechanotherapy. Since 1949, the senior author has operated on 70 cases of professional radiodermatitis. Most of the surgeons affected were oriented towards traumatology or orthopedics. Most of the doctors worked in pneumophtisiology. There was a high degree of radiodermatitis among Italian surgeons and radiologists, apparently due to insufficient shielding of their machines. (BBB)

33866 MENINGIEOMA DEVELOPED UNDER THE EFFECT OF X-RAY TREATMENT IN A CHILD. Horanyi, Bela (Orvostudomanyi Egyetem, Neurologiai Klinika, Budapest). Magy Radiol., 17: 1-7(Feb. 1965). (In Hungarian)

Detailed description of the medical history of a 5-yr-old girl is given who underwent x-ray epilation to treat microsporiasis of the scalp. Data indicate that she received a single dose of 400 R in each of five areas. It is possible, however, that due to faulty equipment, the dose received was larger than indicated. Four months after irradiation a gradual spastic paralysis of all limbs was noted; an almost complete lack of speech and lack of comprehension also occurred. Sight and hearing were partially retained and she responded to pain. Typical radioinduced atrophy of the scalp tissues was noted. The patient died of bronchopneumonia two years later. Autopsy indicated no changes in the organs aside from bronchopneumonia, however, meningieoma was found which had infiltrated the cranium, but had not extensively infiltrated the brain itself. The brain showed signs of radionecrosis. The tumor proved to be a mixed-type meningieoma showing signs of mild malignancy. It is contended that five prerequisites are necessary to identify a brain tumor as having been caused by trauma: (1) The patient be healthy before the trauma; (2) Skull trauma be adequately

strong to cause tumorigenic reaction; (3) Location of the traumatic site and that of the tumor be identical; (4) Adequate time lapse between the trauma and development of the neoplasm; (5) Adequate diagnostic substantiation of the tumor. This case meets all five requisites, and it is suggested that there is no doubt that meningioma was caused by irradiation. (BBB)

33867 RADIATION: MAN AND HIS GENES. Newcombe, Howard B. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Manitoba Med. Rev., 42: 515-21(Oct. 1962).

Genetic effects of radiation are considered broadly, and, in particular, attempts are made to assess the possible genetic consequences of the increasing levels of radioactive materials in the environment resulting from proliferating industrial uses of nuclear energy. To ensure the orderly development of future peaceful uses of nuclear energy, it is necessary that some upper limit to the exposures of whole populations from nuclear byproducts and handling procedures be agreed. How to set these limits in view of the absence of any but the crudest quantitative assessments of biological effects is discussed. To seek complete safety would be unrealistic and would mean that no major development could take place. The reverse approach of allowing great latitude in the disposal of radioactive wastes and the exposures of personnel would, on the other hand, encourage carelessness. The guiding principle must be to obtain the max benefit to man at the min price in terms of the harm done to him. At present the standards have had to be set arbitrarily in so far as the genetic risks to populations are concerned, since neither the risks nor the benefits can be estimated with any degree of precision. The upper limit of 5 R per generation from the future peaceful uses of atomic energy, suggested by one recognized international body, seems reasonable from this standpoint. The estimated number of seriously affected individuals in a population of 20 million from this additional exposure would be about 300 per year (i.e., $\frac{1}{10}$th of the present fatality rate from automobile accidents in Canada and $\frac{1}{200}$th of the injuries). However, such an estimate is subject to very large uncertainties and might be out by as much as tenfold in either direction; geneticists are about equally divided on the question of whether it is useful to attempt such calculations at all. Even this suggested limit of 5 R per generation from peaceful uses of nuclear energy may never be reached. Advances in the methods of waste disposal may make it economically unnecessary to raise the population exposure to this level. Also, with improved estimates of the genetic consequences of exposure, the permissible level may be revised. The possible genetic effects of fallout from nuclear weapons, calculated in a similar manner and assuming indefinitely continued testing at the 1952-56 rate, would be about $\frac{1}{80}$th of those estimated as a result of exposures at the suggested upper limit from the peaceful uses of nuclear energy. Genetic diseases in man are discussed with emphasis on the possible impact of increased radioactivity in man's environment on the mutation rate and incidence of hereditary diseases. (BBB)

33868 DYSFUNCTION OF HAIR GROWTH. Defeo, Charles P. Jr. Med. Clin. N. Am., 49: 603-20(May 1965).

Scalp x-ray burns which result in alopecia are described. Permanent alopecia may develop if about 1200 R of x rays is given. One such case is illustrated. (BBB)

33869 SOME BLOOD BIOCHEMICAL STUDIES IN RADIATION DISEASE. Zaruba, K.; Pazderka, J. (Charles Univ., Hradec Kralove, Czechoslovakia). Med. Pharmacol. Exptl., 12: 121-7(1965). (In German)

Levels of residual nitrogen, creatinine, and mineral ions in blood were studied and the alkali reserve determined in dogs suffering from moderate and severe forms of radiation sickness. Serum proteins were also examined electrophoretically and blood protein levels determined. These parameters were determined 2 to 42 days after dogs received a single whole-body dose of ^{60}Co γ radiation at a rate of 3 R/min. The doses were 300, 500, 600, or 800 R. After the lowest dose, significant changes were noted in blood levels of creatinine (increase, 2nd day), alkali reserve (increase, 42nd day), K (decrease, 7th day), Na (decrease, 4th day), Cl (decrease, 2nd day), and Ca (decrease, 7th day). No significant changes were noted in postirradiation (300 R) levels of blood nonprotein N, total protein, or protein fractions. Similar but more pronounced changes were noted after higher doses. After 500 R, blood nonprotein N declined on the 14th day and total protein on the 4th day. Serum protein fractions were unaffected, except for a decrease in albumin 7 days after 800-R irradiation. Although blood biochemical values generally varied between normal limits during radiation sickness, it is evident from the results that some homeostatic mechanisms are affected in the condition. Disturbances in renal function probably account for most of the observed changes. (BBB)

33870 DIASTATIC ACTION OF BLOOD SERUM BEFORE AND AFTER IRRADIATION OF CANCEROUS PATIENTS. Pavlovic, V.; Trpinac, P.; Vlajnic, R.; Popovic, V.; Nikolic, D. (Medical Faculty, Belgrade). Med. Pregled, 17: 275-8(1964).

Irradiation of a solution of pure alpha-amylase-compounds reduced its action in proportion to the dosage of the irradiation and abolished it at 2000 R. The action was unchanged after irradiation of the blood serum with different doses in vitro. The mean value of diastatic action in 114 cancerous patients was somewhat higher than in healthy persons. The diastatic action of the blood serum before and immediately after irradiation in cancerous patients showed no marked changes. The diastatic action was examined in 80 cancerous patients before a first and after a second irradiation, in 57 patients before a first, after a first, and after a tenth irradiation, in 36 patients before a first, after a first, after a tenth, and after a final irradiation. Changes occurred in 80% of cases, but no systemic conclusions could be drawn. The results obtained show that the analytic action of the blood serum in cancerous patients remains constant independently of the localisation and duration of the disease and of the irradiation therapy. (Excerpta Med.)

33871 THE ACUTE LEUKEMIAS: ANALYSIS OF 322 CASES AND REVIEW OF THE LITERATURE. Boggs, Dane R.; Wintrobe, Maxwell M.; Cartwright, G. E. (Univ. of Utah, Salt Lake City). Medicine (Tokyo), 41: 163-225 (Sept. 1962).

An extensive survey is provided of acute leukemia, with a discussion of possible etiologic factors, such as heredity, viruses, and ionizing radiations. Among the 322 cases studied, there were ten patients with myeloblastic leukemia and seven with lymphoblastic leukemia who had a history of excessive exposure to radiation and two with myeloblastic leukemia had been chronically exposed to benzene. More than 90% of the patients had no history of unusual exposure and such factors as injuries, sepsis, and antibiotic usage did not appear with increased frequency in the histories of patients with leukemia. A variety of drugs such as chloramphenicol, hexachlorcyclohexane, and phenylbutazone have been suggested as leukemogenic for man, but except for x rays and possibly benzene there are no proven leukemogens for man. Previously, it has been noted that the ease with which leukemia may be induced in a strain of mice with x rays does not correlate well with other mouse leukemogens. This suggests that the mode of action of leukemogens may differ. The incidence of leukemia seems to be increasing over and above what might be expected in a more aged population subjected to better diagnostic methods, but there is some suggestion that the rate of rise has slowed or even stopped in children. This suggests that environmental factors are important in the induction of leukemia. Varying rates of leukemia in Aberdeen and Glasgow apparently independent of background radiation, higher urban than rural rates which may relate to the relative ages of the population, a tendency for cases of leukemia in children but not in adults to cluster in Rochester and in Cornwall, and familial instances of leukemia, are all factors which could relate to environment. Geographic variation in rates of leukemia may reflect environment or ethnic differences. Excessive radiation exposure appears to be established unequivocally as leukemogenic. The frequency of myeloblastic leukemia and chronic myelocytic

leukemia were increased in survivors of the atomic bombing of Nagasaki and Hiroshima, and roughly proportional to the survivors' distance from hypocenter. Radiologists, at least those who pioneered the field, have probably suffered more leukemia than the general population and the incidence may be increased in physicians in general. X-ray therapy in eight reports has been associated with an increased frequency of leukemia as well as other tumors; but diagnostic radiation even to the fetus in utero cannot usually be implicated as leukemogenic. Intermediate radiation dosage, such as radioiodine for thyrotoxicosis, has not been clearly leukemogenic. Thus, although it is not possible to rule out an association of leukemia and the disease for which x-ray therapy was used (rheumatic diseases and thymic enlargement), there is little doubt that large radiation dosages predispose to leukemia. Whether or not a threshold exists cannot be determined currently. The presence or absence of a threshold for x-ray induction of leukemia holds the key to its relative importance. If leukemia only relates to very large doses of x rays then it remains an interesting though relatively unimportant factor in the over-all problem of leukemia. If there is some increased hazard of leukemia development with any radiation exposure, then in theory all myeloblastic leukemia and chronic myelocytic leukemia could relate to background radiation. The repeated finding that leukemia, acute or chronic, induced by radiation appears to be of myeloid cell type suggests different etiologic factors in the leukemias of lymphocytic and myelocytic origin. Induced chromosomal aberrancy has been suggested as the mechanism by which x rays act as a leukemogen. The termination of polycythemia rubra vera as myeloblastic leukemia has been noted without therapy but it is possible that this is more frequent in patients treated with x rays and particularly with ^{32}P. Such therapy may relate to terminal myeloblastic leukemia induced de novo, or to acceleration of an already present tendency; prolongation of life to an age at which such a terminal event is more likely; or there may be no relation to therapy. (BBB)

33872 BURNS, FRACTURES, AND SOFT TISSUE INJURIES. MacMillan, Bruce G. (Univ. of Cincinnati). N. Y. State J. Med., 64: 1994-7(Aug. 1, 1964).

The nature of injuries in casualties of thermonuclear weapon explosions is described, and a procedure for handling such casualties is outlined. The blast per se produces few harmful effects on the human body. In close proximity to the blast ear drums will rupture, and some harm may accrue to air-filled lungs and intestines, but the body withstands the pressure exceedingly well. It is the secondary effects of the blasts that are so devastating. From the epicenter to about 2500 ft, most of the mechanical injuries from the indirect blast effect are fatal. From 2500 to 7000 ft most of the injuries are serious; from 7000 to 12,000 ft minor injuries predominate. These distances apply to the smaller bombs only, but they offer a method of planning which can be adapted to larger weapons. The radiation injuries, resulting chiefly from the γ radiation, constitute a moderate problem, although initially this factor is less important than that of the blast and heat, particularly if the bomb bursts in the air in contradistinction to bursting on the ground. The delayed effects of moderate to severe irradiation are those of wound disruption and secondary infection. With reference to the experience at Hiroshima, the relative distribution of casualties is reviewed. The distribution of casualties among those individuals injured immediately following the atomic blast was as follows: 70% suffered from secondary mechanical injuries, 65 to 80% suffered from flash burns, and 30% from both immediate and delayed radiation effects. Some general principles for handling casualties include: (1) Prevention of infection will depend on adequate debridement or incision and drainage; following debridement, all traumatic soft tissue wounds will be left open. (2) Hemostasis will be controlled largely by the application of pressure dressings. (3) Only established infections will be treated with the limited available supply of antibiotics. (4) Gas gangrene can be prevented only by surgical removal of all nonviable tissue. (5) Compound fractures will be placed in the immediate care priority group. (6) Intravenous therapy will be available on a limited basis only; if a limited supply of blood or volume expanders is available, these should be used for the treatment of extremity injuries rather than for intra-abdominal injuries. Initial fluid therapy in thermal and soft tissue casualties will depend on the oral administration of a hypotonic salt and soda solution. (7) Patients developing early, overwhelming infectious complications will be placed in the expectant group of casualties. (8) Exposure therapy will be used exclusively for the local care of all burn wounds, and a bland ointment applied to the burn wound will minimize the need for narcotics. (9) When the tactical situation permits, evacuation to treatment centers should be initiated for: closure of burn wounds by autografting or homografting, intensive intravenous replacement therapy, specific antibiotic therapy, and treatment of severe combined injuries. (BBB)

33873 STUDIES ON HEME SYNTHESIS BY BONE MARROW CELLS IN VITRO AND IN VIVO WITH 2-^{14}C-GLYCINE. II. EFFECT OF RADIATION ON HEME SYNTHESIS BY BONE MARROW CELLS IN VITRO. Fujii, Masahiro (Kyoto Univ.). Naika Hokan, 11: 43-9(1964).

The effect of irradiation on heme synthesis of rabbit bone marrow cells and reticulocytes was studied using ^{59}Fe and 2-^{14}C-glycine in in vivo and in vitro experiments. Some changes in plasma which could occur after irradiation might have an influence upon the heme synthetic activity of erythroblasts or incorporation rate of the isotopes. This possibility was examined by incubating the label with autologous serum samples obtained ten min prior to irradiation and one hr after irradiation. The result showed no change in serum after irradiation with regard to an influence upon heme synthesis in vitro. After 1000-R whole-body x irradiation and 500 to 5000 R in vitro γ irradiation, heme synthesis of bone marrow cells was much decreased. However, the heme synthesis of reticulocyte suspensions was not affected by γ irradiation of up to 3000 R. Irradiation of 5000 R resulted in a slight decrease of heme synthesis, but cellular uptake of ^{59}Fe was the same as that of controls. The results demonstrate the very low sensitivity of heme synthesis to irradiation and high sensitivity of immature erythroblasts to irradiation. The decrease of heme synthesis of bone marrow of irradiated animal or of irradiated bone marrow cell suspension is caused by the damage of early erythroblasts. Thus it has been shown in an in vivo study of ^{59}Fe utilization in irradiated guinea pigs that a radiation dose which reduced the incorporation of ^{59}Fe into the hemoglobin to 30% of that of controls did not diminish the incorporation into cytochrome b of the liver. The relation of irradiation to the mechanism of synthesis of various hemes seems to be the same. Although previous reports have described enhanced heme synthesis of bone marrow cell suspension of rabbit prepared and incubated directly after 800 R x irradiation, in the present experiments this phenomenon was not observed. The results of the present experiments are in agreement with earlier experiments which indicated by an autoradiographic method using ^{59}Fe that iron uptake by erythroblasts was not affected by x irradiation of 100 to 5000 R in 16-to 24-hr cultures and that the proportion of early normoblasts decreased significantly at the end of incubation period. The slight decrease of heme synthesis after 500 R γ irradiation might be the result of damage to the earliest group of erythroblasts. As the irradiation dosage increases the harmful effect would be extended to more mature types of cells. (BBB)

33874 FOOD CONSTITUENTS AS NATURAL PROTECTIVE MATERIALS AGAINST X-RAY-INDUCED CHROMOSOME INJURIES. Barthelmess, A.; Fuerst, H.; Huber, H. (Universitat, Munich). Naturwissenschaften, 52: 160-1 (1965). (In German)

Roots of Allium cepa were treated with aqueous solutions of asparagin, glutamic acid, gallic acid, nicotinic acid amide, pyridoxol, ascorbic acid, riboflavin, vitamin A, vitamin E, and Tween 40. They were then exposed to 100 R. The results of a chromosome damage or mitosis interference were tabulated. With the exception of riboflavin all

the substances gave a statistically good protective effect. (J.S.R.)

33875 EFFECT OF MATERNAL ANTEPARTUM EXPOSURE TO X-RAYS ON LEUKOCYTE CHROMOSOMES OF NEWBORN INFANTS. MacIntyre, M. Neil; Stenchever, Morton A.; Wolf, Bruce H.; Hempel, Joanne M. (Western Reserve Univ., Cleveland). Obstet. Gynecol., 25: 650-6(May 1965).

Chromosome studies were carried out on cord blood leukocytes from 36 infants classified in three groups: those exposed to x rays through maternal pelvimetry; those exposed through other maternal diagnostic x rays near delivery; nonirradiated controls. It is assumed that the cause of the break occurred after chromosomal replication. Since cells in metaphase following in vitro culture have probably undergone mitotic division in culture rather than in vivo, it is assumed the chromatid breaks occurred after irradiation and probably in culture. Differences in mean numbers of breaks per 50 chromosome spreads were not significant at the 5% level. Of abnormal forms sought, only a ring form was noted in the pelvimetry group; no other double-break abnormalities were found in this or either of the other groups. No significance could be attached to this single observation. Aneuploidy, or counts other than 46, could be divided into cells with low counts, counts below 46, and those with high counts (over 46). Low-count mean values for the pelvimetry, other x-ray, and control groups per 50 metaphases were 4.50, 6.75, and 3.143, respectively, and for high counts, 1.07, 1.00, and 0.57. None of these differences is significant at the 5% level. No correlation could be determined between the time interval from x-ray exposure to delivery and the presence of abnormalities. Thus, no significant difference was found to be present between the two irradiation groups and the controls, but a possible trend toward significance involving both chromosome breaks and aneuploidy was seen. It is suggested that diagnostic x-ray examinations be limited during late pregnancy to those cases in which it is absolutely indicated clinically and at dose levels giving with the minimum necessary exposure. Conversely, however, x-ray examination should not be withheld where there is a strong clinical indication. (TCO)

33876 STUDIES ON EXPERIMENTAL LEUKEMIA IN MICE. II. PRESERVATION AND RESISTANCE OF C58 MOUSE LEUKEMIC CELLS. Fujiwara, Hisayoshi (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 76: 419-27(Sept. 1964). (In Japanese)

The two strains of transplantable leukemia in C58 mice, namely OHS-LL (lymphocytic) and OHS-ML (myelogenous), were compared as to the resistance and preservation of leukemic cells in bioassay experiments and for radiosensitivity. Both leukemic cell lines did not survive beyond 24 hr at room temperature, and rapidly lost transplantability at 65°C. For the preservation of leukemic cells it was best to keep them as frozen spleen or whole animals than to keep them as cell suspensions. OHS-ML at 80°C withstood freezing for 60 days and OHS-LL for 47 days, and it should be possible to preserve them for longer periods. OHS-ML was not transplantable below pH 5 and OHS-LL below pH 3, indicating inferior resistance of the former to acid solutions. Both leukemic strains failed to survive transplantation after treatment in NaCl solutions at 0% or over 10%, and showed no difference in osmotic fragility. Both cell strains proved to be graftable after 5 times freezing and thawing at −30°C for 15 min, but not after 5 times repetition of the same procedure at −30°C for 60 min. Both cell lines were not transplantable after lyophilization. The lethal x-ray dose was 8000 R for OHS-ML and 3000 R for OHS-LL. OHS-ML became inactivated by formalin, trichloracetic acid, and marsonin at concentrations over 10^{-1}%, 10^{-2}%, and 10^{-3}%, and OHS-LL at concentrations over 10^{-2}%, 10^{-1}%, and 10^{-2}%, respectively. (BBB)

33877 RADIATION INJURIES DURING PREGNANCY. Czeizel, E. Orv. Hetilap., 105: 2161-7(1964).

Fetal radiation injuries in intrauterine life are discussed based on animal experiments, sporadic clinical observations, and evidence obtained from victims of the atomic bomb explosions in Japan. Irradiation sensitivity of the fetus is several times higher than that of the newborn and the injury may lead to the death of the fetus or cause permanent damage during the whole life of the infant. After discussing the pathogenesis of zygo-, embryo-, and fetopathies, genetic and late damages are dealt with. Pregnant women must be spared as far as possible from all kinds and all quantities of ionizing irradiation. (Excerpta Med.)

33878 DEPTH PERCEPTION IN PRENATALLY X-IRRADIATED RATS. Furchtgott, Ernest; Lore, Richard K.; Morgan, Wesley G. (Univ. of Tennessee, Nashville). Percept. Motor Skills, 15: 703-10(Dec. 1964).

Effects of prenatal x irradiation on depth perception of Wistar rats were investigated in three experiments. Rats which had received 200 R on Day 16 of gestation were inferior to a control group in a T-maze in which the distance of the discriminandum was progressively increased. The rats were on a 6-hr food deprivation regimen. The difference was significant even after the hyperactivity of the irradiated group was partialled out. In experiment two, rats were tested which had received 100 or 200 R on Day 16 of gestation. The observed deficits were directly related to the dose. These rats were on a 22-hr food deprivation regimen. In the 3rd experiment a physical cliff situation was employed. Satiated rats which had received 200 R on Day 16 of gestation jumped more frequently to the far side of the cliff than control animals at the age of 35 and 38 days. The T-maze as well as the physical cliff situation provided data showed deficits in tasks involving depth perception in the prenatally x-irradiated rats. While the major aim was to discern perceptual difference between the irradiated and control rats, other variable may have contributed to the observed deficits. Specifically, differences in learning, activity, and/or emotionality, which numerous studies have shown to differentiate prenatally irradiated from control animals, may have contributed to these results. Learning differences could have contributed to the findings in experiments 1 and 2, but not 3. It was noted however, that is experiment 1, through the fifth block of 10 trials, there were no differences between the irradiated and control groups. The differences in activity and/or emotionality are considered jointly, since these variables usually are interdependent. In experiment 1, activity differences favoring the irradiated group which might have decreased efficiency through lack of discrimination at the choice point were adjusted by means of an analysis of covariance. Even after this adjustment, however, the irradiated group was significantly inferior in the discrimination. Activity and/or emotionality differences cannot be the major factors contributing to the observed deficit in depth perception in irradiated rats. The observed differences appear to be due primarily to changes occurring beyond the retina. There is a considerable evidence for gross cortical defects in rats irradiated with a dose of 200 R on gestation Day 15 or 16. Although 200 R of radiation on Day 15 or 16 kills most of the primitive retinal cells present, the residual cells almost invariably recover the loss and in a few days show no residual injury. Thus, in animals irradiated on Day 15 or 16, cortical injuries seem to have greater permanent deleterious effects than retinal injuries. (BBB)

33879 EVOKED CORTICAL RESPONSES IN X-IRRADIATED RATS. Hrebicek, J.; Kamenicek, O.; Komenda, S.; Schober, B. (Central Radiological Inst., Olomouc, Czechoslovakia). Physiol. Bohemoslov., 14: 70-8(1965).

Attempts were made to detect the effect of radiation on the central nervous system (CNS) by studying electrocortical responses in rats evoked by light stimuli following whole-body irradiation with doses of 300 or 450 R in air of 250-kv x rays. Electrocortical responses to two light flashes, one following the other after 120−130 msec, were tested 24 hr before, 2 hr, 24 hr, and 5 days after irradiation. They were simultaneously recorded in litter pairs, one of which was irradiated, the other serving as control. Differences of the values of 48 train-wave parameters in litter pairs were evaluated by sequential analysis. The pa-

rameters were ranked according to their sensitivities to radiation. All parameters studied before and all 36 studied after irradiation, except 4, proved to be radiation insensitive. The possibility that 4 statistically significant sensitive parameters were obtained by chance can not be excluded on the basis of the statistical design of the experiment. It is concluded that the neocortex shows little functional change after sublethal doses of x irradiation when tested by evoked responses to light stimuli. This conclusion is discussed in connection with data of other investigators and it is proposed that radiation sensitivity of different levels of the CNS, as tested by the indicator used, and not that of the whole CNS, be specified. Thus, it appears that ionizing radiation influences the function of subcortical structures whereas changes of the neocortex are less pronounced. For example, a study of changes of evoked potentials after whole-body irradiation of rats with a dose of 250 R in the prepyriform cortical region, evoked with electrical stimulation of the olfactory tract, a statistically significant shortening of the latency period of the evoked response and a lowering of the amplitude of the response to the second stimulus applied 12–24 msec after the first were seen. The relative late changes which were observed in the cortex of irradiated rats, should they prove to be real, point to the possibility that they are produced by secondary, nonspecific influences and not by the radiation per (BBB)

33880 METABOLIC PATHWAYS IN EXPERIMENTAL SUGAR AND RADIATION CATARACT. Lerman, Sidney (Univ. of Rochester, N. Y.). Physiol. Rev., 45: 98-122 (Jan. 1965).

In a review, citing 178 references, present state of the knowledge of cataract induced by ionizing radiation, as well as by galactose, xylose, and diabetes, is surveyed. Various forms of radiation (both electromagnetic and corpuscular) have been shown to produce cataracts. Of these neutrons, x, and gamma rays possess the most serious cataractogenic potential. Cataracts resulting from these three forms of radiation (both clinically and experimentally) are all similar in appearance, consisting initially of posterior, subcapsular, and cortical opacities. They all require relatively long latent periods before becoming manifest; the length of the latent period is directly related to the dose of radiation exposure. Extensive histochemical investigations have revealed that the earliest changes develop within the cell nuclei, particularly in those cells located at the equatorial zone. There is a rapid and marked inhibition of mitosis occurring shortly after exposure, followed by nuclear fragmentation, degeneration, and extrusion of chromatin material. Immediately after a rat has been exposed to a cataractogenic dose of x radiation there is a marked increase in the turnover of the so-called albuminoid RNA fraction as measured by ^{32}P- and ^{14}C-adenine incorporation experiments. The turnover of albuminoid RNA returns to relatively normal limits by the 2nd or 3rd week, when the initial changes in carbohydrate metabolism become manifest. The concentration of lactic acid begins to decrease at the 3rd week, and a decline in the activity of glucose-6-phosphate dehydrogenase as well as some of the glycolytic enzymes becomes manifest shortly thereafter. A measurable loss in ATP can be demonstrated 1 week after irradiation. Another early change observed in the lens following exposure to x radiation is a rapid fall in the level of SH groups. The most marked decline is in the concentration of glutathione, which becomes manifest about one week following exposure. At the same time the level of ATP in the lens begins to fall, and there is also some evidence concerning an impairment of both the hexose-monophosphate shunt and anaerobic glycolysis. Thus, the initial effects of ionizing radiation may be due to their action on DNA, RNA, and on a cold-precipitable protein fraction. The second stage in radiation cataractogenesis appears to involve damage to the lens fibers and opacification caused by some of the metabolic alterations occurring during the latent period required for this form of cataract to become manifest. Aside from x, gamma, and neutron radiation, other forms of radiation are also known to have a cataractogenic potential to a varying degree. Beta particles, deuterons, long-wavelength uv irradiation, and microwaves also have been shown to produce cataracts in the experimental animal. (BBB)

33881 THE INSUSCEPTIBILITY OF C57 BLACK MICE TO POST-IRRADIATION LEUKEMIA, SOME UNREPORTED POST-IRRADIATION CHANGES. Zebro, T.; Kowalczykowa, J.; Stachura, J. (Medical Academy, Krakow). Polish Med. J., 3: 1143-55(1964).

The results of an attempt to induce irradiation leukemia in mice of the C57 black strain using the usual conditions and doses of x rays are reported. Non-neoplastic focal proliferations of the endothelium and thrombi in liver, spleen, and pulmonary vessels caused death of the irradiated animals 10 to 17.5 months after the irradiation. The changes were diagnosed as a late post-irradiation complication. Only in one of the cases the hyperplasia of the endothelium of the liver vessels was of diffuse character and suggested neoplastic process (endotheliosis). Neither metastases nor similar hyperplasia in the other organs were observed. (Excerpta Med.)

33882 THE EFFECT OF X RAY ON THE PHOSPHORUS METABOLISM OF GLIOMA CULTURES. Palyi, I.; Afra, D.; Posalaky, Z.; Zoltan, L. (Medical Univ., Budapest, Hungary). Proc. Intern. Contr. Neuropathol., 4th, Munich, 1961, 262-7(1962). (In German)

Samples of a human glioma culture were irradiated, 14 days after removal, with 6000 R of x irradiation. The culture fluid was then replaced with a solution containing 6 μC/ml of ^{32}P and incubated for 6 or 22 hr. The uptake of ^{32}P was the same after both incubation periods. As compared to nonirradiated cultures the acid-soluble radioactive P fraction was increased in the irradiated cultures, but the uptake of ^{32}P in the lipid P and DNA P fractions was decreased. The RNA P fraction was unchanged. The acid-soluble P fraction contained the adenylic acid phosphates and hexose phosphates. The decreased lipid P uptake may be a characteristic response of tumor tissue to irradiation, because it was not observed in the normal control tissue. There are two possible explanations for the decreased DNA P uptake. One is that DNA synthesis may have been impaired by irradiation. Another reason may have been the result of depolymerization of the DNA in the irradiated cultures. The results suggest that glioma tissues may be sensitive to irradiation. (BBB)

33883 ELECTRON MICROSCOPY OF ULTRAVIOLET-IRRADIATED PARTS OF CHROMOSOMES. Bloom, William; Oezarslan, Saime (Univ. of Chicago). Proc. Natl. Acad. Sci. U. S., 53: 1294-1302(June 1965).

The steresis resulting in the area of UV irradiation of a chromosome, apparently due to loss of DNA, can be demonstrated by fixation of the cells in 10^{-2} M $CaCl_2$ in 2 per cent aqueous OsO_4 at pH 6.5 or pH 6.0, and subsequent staining with uranyl acetate. The chromosomal constituent(s) which leaves as a result of the irradiation is more clearly shown by fixation with intense ultraviolet light followed by staining (postfixation) with 1 per cent aqueous OsO_4. (auth)

33884 PRIMARY AND SECONDARY MUTATIONS AT THE INCOMPATIBILITY LOCI IN SCHIZOPHYLLUM. Raper, John R.; Boyd, Dana H.; Raper, Carlene A. (Harvard Univ., Boston). Proc. Natl. Acad. Sci. U. S., 53: 1324-32(June 1965).

Data are presented from a study of mutations at the incompatibility loci in higher fungi. Results are reported from studies on mutations induced in several strains of Schizophyllum commune induced by nitrous acid, ethylmethane sulfonate, N-methyl-N'-nitro-N-nitrosoguanidine, or ultraviolet light. (C.H.)

33885 CHROMOSOMAL CHANGES FOLLOWING TREATMENT OF POLYCYTHAEMIA WITH RADIOACTIVE PHOSPHORUS. MacDiarmid, W. D. (University Coll. Hospital Medical School, London). Quart. J. Med., 34: 133-43(Jan. 1965).

Results are reported of chromosome changes found in

leukocytes of 14 patients treated with ^{32}P. The patients with relative polycythemia and secondary polycythemia were given ^{32}P because of known or probable previous major arterial thromboses. The first eight patients were observed before and after their first ^{32}P dose, none having had any form of radiotherapy before. The remainder had received from two to seven injections of ^{32}P on previous occasions. The ^{32}P was administered in all cases intravenously as a single injection of 5.0 ± 1.0 mC, being varied slightly in accordance with differing body weights. Cells with a small number of chromosomes more or less than the diploid number were designated non-modal Type A, having no apparent structural defects in individual chromosomes. Type B cells contained chromatid gaps or breaks, but no other visible structural faults. Type C cells were those with other structural changes in the chromosomes, including (1) acentric chromosomal fragments, dicentric and ring forms, (2) chromosomes with deleted or added parts of their arms making bizarre shapes, and (3) still other cells in which there appeared to be no definitely abnormal chromosome, but the distribution within the groups was abnormal. Practically no chromosome abnormalities were found in untreated patients whose chromosomes resembled those of subjects of the same age who have no hematological disease. After treatment, abnormalities of all the three kinds described above appeared. In two patients who had been treated for the first time, after an initial sharp rise in abnormalities, there followed an early fall towards the baseline levels. Some patients, several months after the first treatment, still had appreciable numbers of abnormalities, suggesting that the chromosomal changes tend to persist. This was invariably so in patients who had received more than one injection of ^{32}P and in whom the numbers of abnormalities found were usually increased following each subsequent injection. None of the patients showed any specific chromosomal abnormality common to all or to a considerable proportion of their cells. Damage appeared to occur in a random fashion affecting any of the chromosomes in a given cell. No Philadelphia (Ph^1) chromosomes were identifiable, such as are found in a high proportion of cases of chronic myeloid leukemia. The incidence of polyploid cells was low. Statistically there was a significant difference between the abnormalities in patients who had never been irradiated and those at any time after one or more ^{32}P injections. The trends after the first treatment were not clear-cut in the group as a whole; this is attributable to the preponderance of data in the first few months after the first injection. The more severe and probably more specifically radiation-induced changes appear to be increased more consistently with increasing amounts of ^{32}P. The degree of chromosomal damage in these patients with polycythemia is less than that found in patients with spondylitis treated with x rays. However, the dose of irradiation, area of administration, exposure time, and the kind of rays are very different. Radiophosphorus is a β emitter with a half-life of 14.3 days and a biological half-life of about 10 days. It was calculated that an injection of 5 mC of ^{32}P will deliver the equivalent of 50 R of whole-body irradiation. A greater share of this irradiation falls on the more actively functioning tissues with a better blood supply, more metabolic activity, and/or mitotic activity. Damage to chromosomes after treatment with ^{32}P in patients with polycythemia may indicate some enhancement by ^{32}P of the risk of leukaemia in these patients. There is a tendency for the higher initial levels of damage to become less after a time, probably owing to the death of damaged cells. The incorporation of ^{32}P into DNA as a strategically situated link in the molecular chain may explain the marked effect of a rather low dose of irradiation. (BBB)

33886 THE VARIATION OF QUANTITATIVE CHARACTERS IN THE IRRADIATED PROGENIES OF TWO RICE VARIETIES AND THEIR HYBRIDS. Jalil Miah, M. A.; Yamaguchi, H. (Tokyo Univ.). Radiation Botany, 5: 187-96(July 1965).

The effects of irradiation with γ rays on the genetic variability of quantitatively inherited economic characters in pure varieties and hybrid populations of rice were evaluated. Dry seeds of both Kinmaze and Sasashigure and F_1 seeds of Kinmaze × Sasashigure were exposed to γ rays from a ^{60}Co source. To study the variability in the X_3 generation, a space-plant row from each X_2 plant was grown in the field, where a randomized block design was laid down with two replications. Data were recorded for several quantitative characters of individual plants. For the X_4 generation, two plants were chosen at random from each of the five highest yielding progenies from each population. The experiment was repeated four times in the field. Frequency distribution of all the characters for the control and each of the X_3 populations were fitted to the expected normal distribution curve. Analyses of variance of the data indicated that the radiation treatment increased variances in most of the characters while the mean value of each treated population was almost the same as that of non-treated populations. It was assumed that mutations for most of the quantitative characters occurred symmetrically in plus and minus directions. The data of the X_4 experiment indicated that one line appeared towards the higher yielding side of the histogram for the irradiated hybrid, while one line appeared towards the lower yielding side of the histogram for control hybrid population. From the results studied it is suggested that manifestation of mutated characters was modified by background genotype, and it was apparent that more desirable variants by the irradiation of hybrid seeds in comparison to irradiation of the seeds of pure varieties could be selected. (auth)

33887 EFFECTS OF THERMAL NEUTRON IRRADIATION ON THE FREQUENCY OF CROWN GALL AND BACTERIAL CANKER RESISTANCE IN SEEDLINGS OF PRUNUS ROOTSTOCKS. DeVay, J. E.; Nyland, G.; English, W. H.; Schick, F. J.; Barbe, G. D. (Univ. of California, Davis). Radiation Botany, 5: 197-204(July 1965).

Seeds of Prunus persica (peach), P. amygdalus (bitter almond), P. mahaleb (cherry), and P. cerasifera (myrobalan plum) used for rootstocks were irradiated with thermal neutrons or x radiation. Comparisons of seed germination, seedling growth, and leaf abnormalities caused by different dosages and kinds of irradiation were made in a pilot experiment to determine the radiosensitivity of the seeds. Thermal neutron dosages of approximately 2.0×10^{13} for peach and almond and 1.5×10^{13} neutrons/cm^2/sec for plum and cherry were used in subsequent experiments of disease resistance. The combined results of a 4-year glasshouse study involving 3000 seeds of each Prunus species showed that the frequency of crown gall (Agrobacterium tumefaciens) resistant seedlings was 2.0 to 8.3 per cent higher in irradiated populations of almond and peach but 6.9 per cent lower in cherry compared with non-irradiated controls. In contrast, bacterial canker (Pseudomonas syringae) resistant seedlings were 2.1 to 22.4 per cent less frequent in irradiated populations of almond and plum but 14.6 per cent more frequent in cherry. Seedlings with combined resistance to canker and crown gall were retested under orchard conditions. No change was found for the canker resistance of plum and cherry; however, some seedlings of peach and almond gave positive reactions to canker, and some seedlings of all stone fruits gave weak crown gall reactions. After the orchard evaluations there were still seedlings of plum, almond, and cherry that had combined resistance to both diseases but their frequency in control and irradiated populations was not significantly different. (auth)

33888 GROWTH OF EMBRYOS ON SYNTHETIC MEDIA AFTER EXCISION FROM GAMMA-IRRADIATED (525 kr) AND UNIRRADIATED WHEAT GRAINS. Long, Terrill J.; Haber, Alan H. (Oak Ridge National Lab., Tenn.). Radiation Botany, 5: 223-31(July 1965). (ORNL-P-96)

Embryos exclusive of scutella were excised from γ-irradiated (525 kr) and unirradiated wheat grains and cultured in darkness on defined media. Growth of the embryos from irradiated grain occurred without detectable cell divisions. Absence of a nitrogen source reduced growth of irradiated and unirradiated embryos to similar extents.

Absence of carbohydrate completely prevented detectable growth in both irradiated and unirradiated embryos. The growth responses of the irradiated embryos to single and mixed carbohydrates were similar to the growth responses of unirradiated embryos in the following respects: dependency of growth on D-glucose concentration; growth on either sucrose or fructose comparable with growth on D-glucose; lesser but significant growth on either D-ribose or D-xylose; incapacity to grow on D-galactose, D-mannose, or L-arabinose; and reduced growth after addition of either L-arabinose or D-mannose to media containing a near optimal concentration of D-glucose. Similarly, addition of D-galactose to media containing a near optimal concentration of D-glucose reduced coleoptile and root growth of both irradiated and unirradiated embryos. By contrast, however, addition of D-galactose to media containing a near optimal concentration of D-glucose greatly reduced first leaf growth of the unirradiated embryos but had little or no effect on reducing the first leaf growth of the irradiated embryos. This differential effect of D-galactose on growth of the first leaf was the only major difference in gross growth characteristics found between the irradiated embryos growing without detectable cell division and the unirradiated embryos. (auth)

33889 EFFECTS OF GAMMA RAY IRRADIATION ON GROWING RICE PLANTS. I. IRRADIATIONS AT FOUR MAIN DEVELOPMENTAL STAGES. Kawai, Takeshi; Inoshita, Tadayoshi (National Inst. of Agricultural Sciences, Hiratsuka, Japan). Radiation Botany, 5: 233-55 (July 1965).

Rice plants at four successive developmental stages, viz. tillering, ear primordia formation, meiosis, and heading were separately exposed to semi-chronic gamma rays from ^{60}Co. Each radiation exposure lasted for five days. Total doses administered were 2, 4, 8, and 16 kR, at any of the stages. Culm length, ear length, and number of spikelets per ear of γ_1 plants were noticeably reduced by irradiations at the two early developmental stages. Fertility of γ_1 spikes was reduced by irradiations at all the four stages of development, although it was affected to different degrees depending on the dosage and the stage of plant development at the time of irradiation. Maximum reduction of γ_1 fertility was observed when treatment was given at the stage of meiosis. Frequency of plants with reduced fertility in γ_2 was high when treatments were given at the two later stages of development. Chlorophyll mutants in γ_2 in the case of irradiation at the stage of tillering were more frequent than those in the case of irradiation at the stage of ear primordia formation. They were only rarely observed in the treatments at the two later stages. When plants were irradiated at the two late stages of development, the number of chlorophyll mutations per 100 γ_3 strains (representing the mutation rate) in the treatment at the stage of meiosis was slightly higher than that in the treatment at the stage of heading. The calculated mutation rate in the case of irradiation at the stage of tillering was nearly the same as or slightly higher than that after irradiation at meiosis. In the case of irradiation at the stage of ear primordia formation, the mutation rate calculated by using the frequency of γ_2 mutants was distinctly lower than that calculated by using the number of mutations per γ_3 strains. (P.C.H.)

33890 RADIATION EFFECTS OF CARBON-14 AND TRITIUM ON GROWTH OF SOYBEANS. Chorney, W. (Argonne National Lab., Ill.); Scully, N. J.; Dutton, H. J. Radiation Botany, 5: 257-63(July 1965).

Soybean plants (Chief variety) were labeled with ^{14}C or ^{3}H by growing the plants from seedlings to maturity in hermetically sealed growth chambers containing either tritiated water or radiocarbon dioxide. Plants cultured for approximately 90 days were labeled at 86.2 μc of ^{14}C and 337.8 μc of $^{3}H/g$ of carbon and hydrogen, respectively. ^{14}C plants developed a significantly greater number of visible main axis nodes than controls while ^{3}H plants developed fewer. ^{14}C and ^{3}H plants yielded significantly fewer pods and seed than controls. ^{3}H plants developed tumor-like enlargements at the stem-tip regions; the youngest leaves exhibited yellow or white chlorophyll-deficient areas. Roots of ^{14}C plants developed numerous nodule-like structures. The ^{14}C and ^{3}H seed did not differ from the control seed in fatty acid composition and in percent oil. ^{14}C and ^{3}H seed planted shortly after harvest developed into normal-looking plants. After storage for 44 weeks, both the ^{14}C and the ^{3}H seed lots germinated but the former failed to survive. Seedlings from ^{3}H seed stored for 44 weeks grew normally except for some leaf-pigment anomalies in the primary leaves. (auth)

33891 EFFECT OF CHRONIC GAMMA IRRADIATION ON EPIDERMAL HAIRS OF SOME VARIETIES OF WHEAT AND BARLEY. Kapoor, M. L.; Joshi, B. C.; Natarajan, A. T. (Indian Agricultural Research Inst., New Delhi). Radiation Botany, 5: 265-9(July 1965).

Several varieties and species of wheat and barley were grown under chronic γ irradiation from 1961–4. The response of these varieties and species, with regard to the development of epidermal hairs on leaves was studied. Some non-hairy wheat varieties (N.P. 797,798,836) were found to develop profuse hairiness, while others did not. The optimum dose for induction of maximum hair production was found to vary with varieties. Species which are normally hairy, were found to have reduced hairiness following irradiation. (auth)

33892 RADIATION RESISTANCE WITH AGE IN NORMAL AND IRRADIATED POPULATIONS OF MICE. Storer, John B. (Jackson Lab., Bar Harbor, Maine). Radiation Res., 25: 435-59(July 1965).

Life table data were obtained on 4083 BDF_1/J (C57BL/6J × DBA/2J) female mice exposed at 90 days of age to 0, 100, 300, or 500 R of x rays. Shortening of median survival was found to be a linear function of dose in this range and amounted to 45 days per 100 R. The regression line went through the zero intercept, and thus no evidence of a threshold dose for this effect was found. In autopsy samples of approximately 100 mice from each of these groups, it was found that tumor incidence was not increased by radiation exposure, although tumors tended to occur earlier in the irradiated groups. The latent period between radiation exposure and a significantly elevated death rate relative to the controls was found to be an inverse function of the size of the radiation dose. For this reason it was postulated that with short-lived mouse strains, low radiation doses, or radiation delivered late in life, the regression line relating dose to life shortening should consist of two segments. One segment would be curvilinear at low doses, and the second segment linear and extrapolatable through the zero intercept at high doses. Sensitivity to radiation exposure as a function of age and previous radiation exposure was measured in terms of $LD_{50(30)}$ and mean survival under 100 R/day. Resistance followed a long plateau, followed by a rapid decline late in life. Previously irradiated mice were less resistant than controls at most ages tested and showed an earlier onset in decline in resistance. With respect to this index of aging, the irradiated mice reacted as though prematurely aged. A similar reaction was demonstrated with respect to changes in body weight. (auth)

33893 POTENTIATION OF THE LETHAL ACTION OF IONIZING IRRADIATION ON BACTERIA BY CHLORAL HYDRATE AND RELATED COMPOUNDS. Burns, James; Garcia, John P.; Lucas, Mary; Monorief, Carolyn; Pittillo, Robert F. (Southern Research Inst., Birmingham, Ala.). Radiation Res., 25: 460-9(July 1965).

Studies were made on the effects of chloral hydrate and other halogenated compounds on the potentiation of radiation kill of bacteria, in particular E. coli. Concentrations of chloral hydrate of less than 0.001 M failed to potentiate radiation kill, but concentrations of 0.002 M or greater significantly potentiated radiation kill. Chloroform and other halogenated compounds structurally related to chloral hydrate were also observed to significantly increase radiation kill of E. coli. Notably active compounds in this regard were chlorobutanol, 2,4-dichlorophenoxyacetic acid, and dichloroacetic acid. (P.C.H.)

33894 MODIFICATION OF THE RELATIONSHIP BETWEEN GROWTH AND METABOLISM IN SEEDS BY X-

IRRADIATION. Surrey, Kenneth (Argonne National Lab., Ill.). Radiation Res., 25: 470-9(July 1965).

The relationship between growth and metabolism of x irradiated sunflower (Helianthus annuus) seeds determined by the use of lipoxidase activity as an index of cotyledon metabolism and hypocotyl growth as an index of radiosensitivity of the embryo. Although growth was inversely related to the metabolism, the actual magnitudes of the relation between these two parameters differed for each range of x-ray exposure. Growth was markedly reduced by doses up to 100 kR, but the enzyme activity remained relatively unaffected. A gradual reduction in lipoxidase metabolism as well as in residual growth occurred in the range 100 to 400 kR, and above 400 kR a complete cessation of both the responses constituted the final phase of radiation action. With the complexities of radiation action on growth and metabolism acknowledged, the results suggested that x rays affected the primary radiosensitive locus—that is, the embryo. The amount of injury to the embryo was reflected in the hypocotyl growth, and finally it was this growth process that ultimately determined the levels of metabolism in the cotyledons at various stages of the seedling development. The embryo and cotyledons were found to initiate physiological activities independently. Their independence was shown in their levels of radiosensitivity. Normal hypocotyl growth of the sunflower seed was inhibited close to the minimal growth level with exposures of about 60 kR, whereas nearly seven times as much radiation was required to stop the initiation of lipoxidase metabolism in the cotyledons. (auth)

33895 ACCUMULATION OF LETHAL IRRADIATION DOSES BY FRACTIONATED EXPOSURE TO X-RAYS. Krebs, J. S.; Brauer, R. W. (Naval Radiological Defense Lab., San Francisco). Radiation Res., 25: 480-8(July 1965).

The LD_{50} of mice for exposure to daily fractionated irradiation was measured for fractionation periods of 5 to 60 days. The amount of recovery did not agree with the model involving exponential decay of injury with time after exposure. The results suggest that the biological basis for the recovery is the prompt repair of sublethal injury to vital cells of the mouse during the intervals between exposures to radiation. The existence of similar recovery patterns in previous studies of dose fractionation is pointed out. The relationship of the present pattern of radiation exposure to other patterns for chronic radiation exposure is discussed briefly. (auth)

33896 CHANGES IN ULTRASTRUCTURE OF DUODENAL CRYPTS IN X-IRRADIATED MICE. Hugon, J.; Maisin, J. R.; Borgers, M. (CEN, Mol, Belg.). Radiation Res., 25: 489-502(July 1965).

The effects of ionizing radiation in the crypts of the duodenum of mice were studied at the ultrastructural level during the first 24 hours after a dose of 1350 R of x rays. The following changes were observed in the stem cells: At 30 minutes after irradiation, the lesions consist in breaks in the plasmic mitochondrial, and granular membrane. The other organelles are apparently undamaged. At 3 hours after irradiation, the presence of large cytolysomes, distorted nuclei, and numerous swollen mitochondria are the prominent injuries. At 24 hours after irradiation, most of the stem cells show an atrophy of microvilli, and many nuclei are enlarged and multilobated. It must be noted that at this time only a few cytolysomes are still present in the cytoplasm; many mitochondria have normal appearance. The centrosomes in the cells are normal at all times after irradiation. Goblet, Paneth and enterochromaffin cells show only small modifications in their morphology. (auth)

33897 THE RADIATION SENSITIVITY OF A TRANSPLANTED LYMPHOMA AS DETERMINED BY TWO DIFFERENT ASSAY METHODS. Bush, R. S.; Bruce, W. R. (Univ. of Toronto and Ontario Cancer Inst., Toronto). Radiation Res., 25: 503-13(July 1965).

The radiosensitivity of a line of transplanted murine lymphoma cells was found to be characterized by a D_0 of 114 ± 4 rads when the spleen-colony method was used to assay viability, but was 133 ± 8 rads when a serial dilution assay was used. The difference could not be attributed to a change in the fraction of colony-forming cells that reached the spleen post irradiation, to a homograft reaction to the cells, or to a separate identity of colony-forming and malignant cells. The difference may be due either to a post-irradiation heterogeneity in the growth properties of the irradiated cells or to a difference in the survival of lymphoma cells depending on their post-irradiation environment. (auth)

33898 WEIGHT AND BLOOD VOLUME CHANGES INDUCED BY IRRADIATION OF THE AMERICAN COCKROACH. Wharton, D. R. A.; Wharton, Martha L.; Lola, John E. (Army Natick Labs., Natick, Mass.). Radiation Res., 25: 514-25(July 1965).

Exposure of the cockroach to 10,000 rads of β radiation from a 2-Mev Van de Graaff electron accelerator caused an early and continuous loss of body weight, except on the third day after irradiation. The body weight of the whole irradiated insect on the third day after irradiation was greater than that of the fed or the starved controls because of an excessive intake of water, much of which is retained in the crop. Body weight became more irregular with dehydration and an increasing mortality rate. Percent weight losses in the intestine, fat body, and gonads were greater than in the body at large. The fat body lost less weight in the irradiated insects than in the controls, possibly because of the lower metabolic rate or of retained metabolic water. The blood volume percent (microliters per 100 mg of body weight) was much reduced postirradiation, and an increasing number of insects failed to bleed as the mortality rate rises. The percent total body water of the whole irradiated insect was greater than in the fed and similar to that of the starved controls. The similarity was due to the generally large intake of water by the irradiated insects. When the intestines were removed, the body water was found to be less and differently distributed in the irradiated insect. The probable causes of water changes are discussed. (auth)

33899 EFFECTS OF WHOLE-BODY IRRADIATION ON RENAL FUNCTION AND RENAL HEMODYNAMICS IN THE DOG. Liu, Ching-tong; Overman, R. R. (Univ. of Tennessee, Memphis). Radiation Res., 25: 552-65 (July 1965).

Changes in renal function and renal hemodynamics of dogs receiving 500 R of whole-body x irradiation were studied for 13 days or until shortly before death. During the post-irradiation period, although the renal excretory patterns of K^+ and Ca^{2+} were not altered, the percentages of tubular reabsorption for Na^+ and Cl^- were increased. A reduced clearance of osmolality was also found at the terminal stage. No significant change was found in glomerular filtration rate, effective renal plasma flow, total renal blood flow, filtration fraction, clearance of urea, or TmG in the x irradiated animals. However, the maximal tubular excretory capacity was diminished as indicated by a reduced TmPAH. (auth)

33900 RADIATION AND WOUND HEALING: A STUDY OF THE ROLE OF SULFUR AMINO ACIDS. Kinnamon, Kenneth E.; Sutter, John L. (Fitzsimons General Hospital, Denver). Radiation Res., 25: 566-73(July 1965).

Eight hundred rads of whole-body irradiation received by albino rats was not found to affect wound regenerate content of total methionine or total cystine. Neither did the acute exposure alter ^{35}S-methionine ^{35}S-cystine, total sulfur-35, or total sulfur-35 minus ^{35}S-sulfate regenerate levels after tracer injections of ^{35}S-methionine. The irradiation did, however, cause a reduction in wound collagen content. (auth)

33901 LATE EFFECTS OBSERVED IN BURROS SURVIVING EXTERNAL WHOLE-BODY GAMMA IRRADIATION. Brown, D. G.; Johnson, D. F.; Cross, F. H. (Univ. of Tennessee, Oak Ridge). Radiation Res., 25: 574-85(July 1965).

The status of female burros surviving single and multiple exposures of γ radiation for periods of 10 and 13

years is described. Mortality ranged from 10% in the 320-R group to 50% in the 545-R group; there are no deaths in the controls. The majority of deaths were associated with physiologic and pathologic changes comparable to early irradiation injury observed in burros. The principal lesion was thrombocytopenia with a corresponding decrease in megakaryocytes in the bone marrow. Fertility did not appear to be affected, and no adverse effects were observed in the offspring from irradiated survivors. (auth)

33902 MODIFICATION OF GENETIC RECOMBINATION OF ESCHERICHIA COLI K-12 PRODUCED BY ^{32}P DECAY IN THE FEMALE. Krisch, Robert E.; Wood, Thomas H. (Univ. of Pennsylvania, Philadelphia). Radiation Res., 25: 601-7(July 1965).

The decay of ^{32}P in the Hfr donor cell before mating is known to affect the genetic recombination of E. coli K-12 primarily by interrupting chromosomal transfer. Studies indicated that ^{32}P decay in the recipient cell before mating acts primarily to modify later stages of genetic recombination by bringing about a preferential utilization of male genetic information in viable recombinant cells. At high dose levels the only viable recombinants are those that receive their genetic information almost entirely from the male chromosome. These genetic effects are very similar to those previously reported for x ray or α-particle irradiation of the female. (auth)

33903 ELECTRON MICROSCOPE INVESTIGATION OF FLEXIBILITY OF NATIVE AND DENATURED DNA FORMS. Tongur, A. M.; Ryabchenko, N. I.; Pasynskii, A. G.; Tseitlin, P. I. (Inst. of Biochemistry and Inst. of Biology, Academy of Medical Sciences, Moscow). Radiobiologiya, 5: 330-3(1965). (In Russian)

Electron-microscope photographs of single-strand DNA, obtained from non- and x-irradiated DNA, appeared as long threads when taken from doubly distilled water. These were twisted into balls when the electrolyte concentration in the solution was higher. Macromolecules of native DNA did not change shape with increasing electrolyte concentration. (tr-auth)

33904 BIOLOGICAL ACTIVITY OF GLOBULIN EXTRACTED FROM PERFUSATE OF THE TISSUES OF IRRADIATED AND NON-IRRADIATED DOGS (EXPERIMENTS ON RABBITS). Lĭtsyna, G. M.; Balika, Yu. D. Radiobiologiya, 5: 334-7(1965). (In Russian)

Internal administration to rabbits of globulin (IG) extracted from perfusates of irradiated dog tissues caused a statistically significant decrease in the rabbit erythrocyte count. Similar globulin preparations (non-IG) from nonirradiated dogs caused a decrease in the erythrocytes in some rabbits, but the decrease was not so great and did not last so long. The leukocyte count after 2 or 3 days was about 5 times the normal in both cases. Reticulocytes decreased 30–40% and neutrophils increased 2- or 3-fold. Bactericidin activity of the skin and the phagocytic activity of the blood were not affected. IG did not affect the microflora of the mouth cavity although non-IG changed it significantly. (IIC-M.G.)

33905 IRRADIATION INFLUENCE ON BIOSYNTHESIS IN THE CORTEX OF ADRENAL GLANDS. Ivanenko, T. I. (All-Union Scientific Inst. of Experimental Endocrinology, Moscow). Radiobiologiya, 5: 338-41(1965). (In Russian)

Three hours after x irradiation of rats with a lethal dose (700 R), aldosterone in the adrenal in vitro was higher than normal. Corticosterone was unchanged. One day after irradiation the aldosterone synthesis rate was normal, and the corticosterone rate was the same as in normal rats. Also, adrenal tissue incubated in the presence of progesterone and deoxycorticosterone showed 21- and 11-β-hydroxylase activity unchanged. (tr-auth)

33906 CONTENTS OF CALCIUM IN GUINEA-PIG BLOOD VESSELS DURING IRRADIATION. Polikarpova, L. I. Radiobiologiya, 5: 342-4(1965). (In Russian)

Calcium in the aorta tissue of lethally irradiated guinea pigs did not differ significantly from normal. (tr-auth)

33907 HEMATOPOIESIS IN DOGS RECOVERING FROM CHRONIC ^{90}Sr AND GAMMA-IRRADIATION. Sedricheva, E. N. Radiobiologiya, 5: 345-9(1965). (In Russian)

Dogs were given ^{90}Sr, subjected to gamma irradiation, or both over a period of time to doses two orders greater than the permissible level and then 1% of the body weight was bled. Experimental animals showed only slight erythropoiesis and decreased leuko- and thrombopoiesis. Controls showed normal blood-generating response: reticulocytosis accompanied by erythro- and leukocytosis. (IIC-M.G.)

33908 HEART ACTIVITY DISTURBANCES IN THE PROGENY OF RATS DAMAGED WITH ^{90}Sr. Levchenko, M. A. Radiobiologiya, 5: 350-3(1965). (In Russian)

Rats in the third litter of parents injured by ^{90}Sr (0.4 $\mu C/g$) showed less frequent heart contractions over a 14-day period, apparently the result of interference with the sympathetic nerves to the heart. Adrenalin caused lower voltage and rhythm in the EKG and numerous ventricular extrasystoles in experimental animals of all age groups. (tr-auth)

33909 X-RAY INFLUENCE ON REGENERATIVE ABILITY OF RAT SCIATIC NERVE IN LOCAL AND WHOLE-BODY IRRADIATION. Evsyukov, V. I. (Central Scientific Research Inst. of Roentgen-Radiology, Leningrad). Radiobiologiya, 5: 354-8(1965). (In Russian)

Irradiation, 0.6 kR, of the extremities and of the whole-bodies of rats did not interfere with regeneration of a nerve trunk that was cut through 24 hr later. The morphological picture during regeneration was normal, as were the size and density of neuromas. Irradiation of the extremities to 1.5 kR depressed the regeneration process and irradiation to 3 kR depressed it sharply. The depression occurred not only immediately but 20, 60, and 127 days after the irradiation. In the regenerating nerve the phagocytic function of the neurilemma cells was decreased. No changes were seen in the degeneration processes in the cut nerve. (tr-auth)

33910 ON DETECTING SOME MICROELEMENTS IN RADIATION DERMATITIS. Prokopchuk, A. Ya.; Sosnovskii, A. T. (Minsk State Medical Inst. and Belorussian Scientific-Research Inst. of Dermatology and Venereal Disease, Minsk). Radiobiologiya, 5: 359-61(1965). (In Russian)

The cobalt and zinc contents of blood and damaged skin of irradiated rabbits were somewhat high. Nickel was normal in the blood but somewhat high in the damaged skin. At the height of development of radiodermatitis copper was high in both blood and damaged skin. (tr-auth)

33911 DELAY OF DIVISION AND INTERPHASE DESTRUCTION OF MAMMALIAN BONE MARROW CELLS AS INDICES OF THEIR DIFFERENTIAL RADIOSENSITIVITY DURING DIFFERENT CELL CYCLE PHASES AFTER 50 R X IRRADIATION. Aleksandrov, I. D. (Inst. of Biological Physics, USSR Acad. Sci., Moscow). Radiobiologiya, 5: 371-7(1965). (In Russian)

X irradiation, 50 R, of male white mice depressed bone marrow mitosis, resulting generally in cell destruction. Prophase, metaphase, and ana-telophase cells were examined at intervals from 0.25 to 66 hr after irradiation. (IIC-M.G.)

33912 DELETIONS IN E. COLI B/r INDUCED BY X-RAYS, UV LIGHT, AND NITROUS ACID. Myasnik, M. N. (Inst. of Biological Physics, Moscow). Radiobiologiya, 5: 378-81(1965). (In Russian)

In a series of Escherichia coli mutants, all 67 produced by x irradiation were capable of spontaneous reversal, as were 14 of 49 irradiated with uv light and 7 of 28 treated with nitrous acid. Joining of complementary strands of DNA molecules rather than chromosome breakage is suggested as the mechanism of bacterial division. (IIC-M.G.)

33913 INFLUENCE OF SUB-LETHAL GAMMA IRRADIATION ON GROWTH AND DEVELOPMENT OF CHICKS. Pegel'man, S. G.; Vakher, Yu. I. (Inst. of Experimental

Biology, Estonian SSR). Radiobiologiya, 5: 382-9(1965). (In Russian)

Gamma irradiation (^{60}Co) of 12-day-old White Leghorn and New Hamsphire chicks at a rate of 4.5 R/min showed the $LD_{50/30}$ to be 1000 R. Up to 300 R the irradiation stimulated growth in the first month, with maximum stimulation at 20-50 R. Growth was depressed with doses from 600 to 1000 R. The spleen, thymus, and gonads become smaller with increasing dose, but the liver and adrenals showed no change. No decrease in egg yields of pullets was observed. (tr-auth)

33914 HISTOCHEMISTRY OF ADRENAL GLAND NUCLEIC ACIDS DURING WHOLE-BODY ^{60}Co GAMMA IRRADIATION. Khamidov, D. Kh.; Zufarov, K. A.; Saidaliev, Z. G. (Inst. of Nuclear Physics, Uzbek SSR). Radiobiologiya, 5: 390-2(1965). (In Russian)

Whole-body gamma irradiation (^{60}Co) of male white rats to 400 R caused a prolonged reaction of the blood vessels (dilation, leukostasis, leukocytic infiltration, hemostasis, hemorrhage, endothelial cell swelling, etc.) and adrenal epithelium (decrease in vessel lumens, shrinkage, vacuolization, breakage, polymorphism, etc). Synthesis and destruction of nucleoproteins were interfered with, resulting in a sharp decrease in RNA and decrease in nuclear RNA in the adrenal cortex. In surviving animals the nucleic acid changes were sometimes of the opposite type. The comparatively frequent appearance of the epithelial cell mitosis pattern 5, 10, or 15 days after irradiation indicated a stimulating effect of the doses used. The different zones of the adrenals had different radiation sensitivities, the glandular zone being most resistant. (tr-auth)

33915 CYTOLOGICAL ANALYSIS OF THE ACTION OF HIGH-ENERGY PROTONS. V. COMPARISON OF THE ACTION OF 660-Mev PROTONS AND ^{60}Co GAMMA RAYS ON TESTICLES. Gaidova, E. S.; Ivanov, V. N.; Yarmonenko, S. P. (Inst. of Industrial Hygiene and Occupational Diseases, Moscow). Radiobiologiya, 5: 393-401(1965). (In Russian)

The overall action of 660-Mev protons and ^{60}Co gamma radiation caused reverse changes in the testicles of VALV mice at 500- to 700-Rad doses and in nonpedigreed rats at 250 Rads, due to destruction followed by restoration of function of the cellular elements. At 685-Rad proton or 430-Rad gamma doses, most animals showed a decrease in ability to reproduce in the first half year with later recovery. The relative biological effectiveness of 660-Mev protons was 0.6-0.7 that of ^{60}Co gamma in the first half year after irradiation. (IIC-M.G.)

33916 PECULIARITIES OF DAMAGES OF HEN BLASTODERM CELLS INDUCED BY IRRADIATION IN OVO. Korogodina, Yu. V. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 5: 402-8(1965). (In Russian)

The effects of irradiation of chicken blastoderm cells in ovo, such as a reversible delay in cell division and appearance of chromosome aberrations, were the same as found by others in both the embryo and tissue cultures. Significant numbers of irradiated cells of the activity proliferating embryo tissue were destroyed during interphase, the time, after irradiation at which this occurred being unrelated to cell division. Interphase destruction was principally of cells in the central part of the embryonic disc and was apparently related to its specific function (preparation for differentiation). (tr-auth)

33917 CYTOCHEMICAL AND ELECTRON MICROSCOPIC INVESTIGATION OF EARLY CHANGES IN EHRLICH ASCITES CARCINOMA CELLS INDUCED BY IONIZING IRRADIATION. Aref'eva, A. M.; Gutkina, A. V.; Enenko, S. O.; Mityushin, V. M.; Shungskaya, V. E. (Inst. of Biological Physics, Moscow). Radiobiologiya, 5: 409-14(1965). (In Russian)

The morphology, cytochemistry, and ultrastructure of Ehrlich ascites carcinoma cells irradiated with 2.5, 5, or 10 kR from a cesium source were studied. The first destruction observed (15 min, 1 hr) was in the cytoplasmic structures: mitochondria, RNP, ribosomes, and ergastoplasmic network. Nuclear changes were less obvious. (tr-auth)

33918 EFFECT OF TEMPERATURE ON THE ACTIVITY OF ALKALINE PHOSPHATASE GAMMA-IRRADIATED WITH ^{60}Co. Nikol'skaya, E. B.; Den'ga, V. V.; Ivanenko, E. A.; Popova, I. V. (Leningrad Medical Inst. of Sanitation and Hygiene). Radiobiologiya, 5: 464-5 (1965). (In Russian)

Significant in activation of alkaline phosphatase solutions (0.008 mg/ml) by 3 or 7.5 kR of ^{60}Co gamma irradiation at temperatures from 7 to 50°C began at 20°C. The rate of inactivation increased rapidly with increasing temperature to 50°C. (IIC-M.G.)

33919 CHANGES IN WATER EXCHANGE IN RAT LIVER UNDER THE INFLUENCE OF IONIZING RADIATION. Madievskii, Yu. M.; Kolesnikova, G. S. (Kharkov Scientific-Research Inst. of Medical Radiology). Radiobiologiya, 5: 468-70(1965). (In Russian)

Results of experiments on white rats indicated that radio-induced changes in the physico-chemical properties of the liver cell protoplasm protein complex both in vivo and in vitro show up very early in the hydration capacity. (IIC-M.G.)

33920 PHAGOCYTIC ACTIVITY OF BLOOD NEUTROPHILS IN WHITE RATS EXPOSED TO CHRONIC TREATMENT WITH ^{45}Ca. Ternov, V. I. (Inst. of Industrial Hygiene and Occupational Disease, Moscow). Radiobiologiya, 5: 470-3(1965). (In Russian)

The digesting capacity of neutrophils and blood plasma was more resistant to ^{45}Ca radiation than the absorbing function of blood cells. Comparison of changes in phagocytosis of micrococci and intestinal bacilli (strain 675) showed that damage to the absorbing capacity of the neutrophils for intestinal bacilli occurs earlier and is greater than on micrococci. (tr-auth)

33921 EFFECT OF ACUTE RADIATION SYNDROME ON REACTION OF RAT NERVOUS SYSTEM TO BURNS. Genes, V. S.; Kogan, I. A. (Kharkov Inst. of Medical Radiology). Radiobiologiya, 5: 476-8(1965). (In Russian)

X-irradiated (342 – 1368 Rads) rats that were burned (30 – 35% mortality) showed lower skin sensitivity, higher muscular accommodation, and longer chronaxie. (IIC-M.G.)

33922 PARAMAGNETIC STRUCTURES IN BIOLOGY. Garsou, J. L. (Universite, Liege). Rev. Belge Pathol. Med. Exptl., 29: 249-71(Jan. 1963). (In French)

Biological effects of x rays and γ rays are discussed. The formation of radicals and triplet states may be produced by excitation and ionization combined, and irradiation has been used to study radicals in particular; studies with water, amino acids, peptides, proteins, and nucleic acids are mentioned, in addition to references to secondary biological effects and studies of free radicals in coal and petroleum. Chemical protection against radiation is briefly reviewed. The effect of paramagnetic structures on carcinogenesis and possible mechanisms of cancer formation involving paramagnetic structures are discussed. Relations between condensed aromatic systems and carcinogenesis are mentioned in terms of ease of formation of free radicals, but opposing theories are also taken into account. Finally, relevant quantum chemical calculations for aromatic systems are reviewed. Calculations for nitrogen bases are mentioned particularly in connection with the application of such compounds to the chemotherapy of cancer. (BBB)

33923 THE PLEURAL UNITY OF HEMATOPOIETIC LINES OF CELLS. Mathe, G.; Amiel, J. L. (Institut Gustave Roussy, Villejuif, France). Rev. Franc. Etudes Clin. Biol., 8: 973-8(Dec. 1963). (In French)

A review, including a discussion of the effects of radiation on bone marrow, is given. (BBB)

33924 PHYSICAL, CHEMICAL, AND BIOLOGICAL AGENTS IN FOOD PRODUCTS. Viayna Roca, Enrique. Rev. Sanidad Hig. Publica, 37: 330-61(Aug.-Oct. 1963. (In Spanish)

The actions of ionizing and nonionizing radiations, among

other agents, on foods are reviewed, with discussions on the possible significance to human health and on the nature and reactions of free radicals generated in food products by ionizing radiation. (BBB)

33925 THE EFFECT OF X RAYS ON THE INTRASPLENIC OVARIAN TRANSPLANT IN THE RAT. Fels, E.; Schlanger, P. (Instituto de Maternidad Ramon Sarda, Buenos Aires). Rev. Soc. Arg. Biol., 39: 92-6(Apr.-July 1963). (In Spanish)

Adult female rats received local x irradiation in the ovarian region to doses of 500, 600, or 750 R, given in one session, or 1200 R, given in two sessions of 600 R each. Ten days later the irradiated ovaries were auto- or homotransplanted to the spleen of castrated recipients. Upon autopsy 237 to 304 days later, blastomatotic changes were seen in >70% of the transplanted ovaries, as well as tumors in 28.8% of the autotransplanted and 64.7% of the homotransplanted irradiated ovaries. Whole-body irradiation of the rats with 100 to 200 R, one week after intrasplenic transplantation of ovary, tended to reduce the incidence of ovarian tumors. It was concluded that combination of irradiation of the ovary and its transplantation into spleen is not as effective as either procedure alone in inducing tumors. (TCO)

33926 EFFECT AND DOSAGE OF IONIZING RADIATION. Pohlit, W. (Max-Planck Institut fuer Biophysik, Frankfurt am Main). Roentgen- [Lab.] Praxis, 17: 285-9(Dec. 1964). (In German)

In order to help evaluate the effects of irradiation it is necessary to have some knowledge of its physical, chemical, and biological effects, as well as the characteristics of its energy dissipation. The photoelectric effect, Compton effect, and electron pair formation are reviewed. The mechanisms responsible for the direct and indirect processes of free radical formation are described and illustrated. The relations of these processes are demonstrated for biochemical substances contained in living cells, such as DNA and RNA, and the possible role that these effects may have in enzymatic reactions is discussed. The example given demonstrates how the chemical changes produced by irradiation may affect the life processes of the cell at many points, and thus how they can produce biological effects. Usually, the more closely an effect is related to a certain chain of reactions the more it is related to the biological irradiation effect produced. It is usually also more difficult to measure accurately. For instance, it is relatively easy to measure the amount of radiation that an object received, but it is much more difficult to evaluate its energy distribution within a cell in terms of actual biological effect. (BBB)

33927 COSMIC RADIATION AND CANCER. II. INFLUENCE OF COSMIC RADIATION ON INDUCED CANCER AT HIGH ALTITUDES AND AT SEA-LEVEL. Ong, S. G. (Inst. of Epidemiology and Microbiology, Academy of Medical Science, Peking). Sci. Sinica (Peking), 14: 729-48(May 1965).

The mean latent period for the induction of tumors in mice was decreased significantly with increasing altitude, i.e. from sea-level to 1200 and 2400 m. The percentage of tumors of mice kept at sea-level and at 1220 m was the same, at 2400 m it was increased significantly. If the mice were exposed to cosmic radiation under 1 cm Pb, the effect of the photon-electron showers was the decrease of the mean latent period at the three heights. The decrease was proportional to the number of showers. If the mice were exposed to the maximum number of photon-electron showers (2 cm Pb), the decrease of the mean at sea-level and at 1200 m was larger than that observed under 1 cm Pb. However, at 2400 m the mean was increased significantly. If the mice were exposed to the penetrating showers under 10 cm Pb the mean was increased at sea-level and it was decreased significantly at 1200 m and at 2400 m. A decrease of the mean is generally associated with an increase of the percentage of tumors. There was no significant difference in the mean latent period nor in percentage of tumors between male and female at the three heights 92 days after injection with 0.76 mg of 20-methyl-cholanthrene in 5% solution of Tween 80. However, 146 days after injection the female showed a significant increase in percentage of tumors as compared with that of the male at sea-level. Daylight with ultraviolet light produced a slight increase in percentage of tumors at the three heights. However, 146 days after injection the percentage of tumors of mice exposed to daylight and ultraviolet light was significantly higher than that of mice kept in darkness. A regression of tumors was observed when mice with large tumors were exposed to the effect of maximum number of photon-electron showers (2 cm Pb) at 2400 m. (auth)

33928 RADIATION-INDUCED INCREASES IN FITNESS IN THE FLOUR BEETLE TRIBOLIUM CONFUSUM. Crenshaw, John W. (Univ. of Maryland, College Park). Science, 149: 426-7(July 23, 1965).

Polygenic mutations were induced in an inbred strain of Tribolium confusum by exposure to 500 roentgens of gamma radiation. Female progeny of irradiated males bearing induced mutations in the heterozygous state produced significantly more viable offspring than control female progeny of nonirradiated males. (auth)

33929 STUDIES ON THE PRODUCTION OF BUD SPOTS IN TULIPS BY IONIZING RADIATION. IV. COMPARISON OF COLOR SPOTS INDUCED BY γ RAYS WITH SIMILAR VIRUS DISEASE PHENOMENA. Nezu, Mitsuya (Toyama Agricultural Experiment Station, Japan). Seiken Jiho, 15: 87-97(Dec. 1963). (In Japanese)

A study was made of the effects of γ and electron radiation and of two mutagenic ethylene derivatives on the alteration of flower color; also, the tendency toward color change induced by γ rays was compared with that observed in virus-induced disease. To examine the γ-ray effects on flower pigment formation, the anthocyan constitution of γ-ray induced color spots was investigated paper-chromatographically. Color spots on the perianths were readily induced easily by γ rays and were observed during the first season. Some varieties did not show any change, while many others changed from their original color to other definite shades; thus, white or yellow varieties mostly changed to red (in 26 out of 37 varieties), one white changing to yellow, and one yellow to purple. In a white variety, red spots were induced by 1.29-Mev electrons of a Van de Graaff electrostatic generator, also by ethylene oxide or ethylene imine, like those induced by γ rays. However, in some yellow varieties, although red spots were induced by γ rays, none appeared when treated with the chemicals. Color change after natural infection with virus disease was observed in 23 varieties. No red spots like those observed after γ irradiation appeared in white and yellow varieties. On the other hand, the colored varieties appeared to fade and in one case in the same flower showed both faded and darkened parts. The red spots induced by γ rays in white and yellow varieties contained mostly two kinds of anthocyan, namely, pelargonidin-3-rhamnoglucoside and cyanidin-3-rhamnoglucoside (A_1 and A_2), and in one case, purple spots of Golden Harvest contained three kinds of anthocyan, namely, delphinidin-3-rhamnoglucoside (tulipanin, A_4) in addition to the two anthocyans mentioned above. The same procedure was used to analyze natural and induced mutants in the variety Athleet which was originally derived from Weber (top edge pink) by natural bud mutation. The Weber type was also obtained spontaneously and in higher frequency by γ irradiation. These Weber types and the original Weber variety contained only one anthocyan, A_2. On the other hand, red spots induced by γ rays in the first and fifth seasons contained A_2 and A_1. Differences between color changes induced by γ rays and by viruses were observed; they were pronounced in white and yellow varieties, but none were found in other colored varieties (owing to the peculiar shape of perianth segments induced by γ rays, the two treatments could be easily distinguished). Since color changes were induced not only by γ rays but also electron irradiation and mutagenic chemicals, the color spots induced by γ rays are probably not of chimeric nature but represent somatic mutations of epithelial or primordial cells of perianth tissue. The change, when occurring, was in a definite direction in white and yellow varieties, e.g., no change or change to red, pur-

ple, and yellow, and the difference between red and purple color was due to different anthocyan constitution. These results show that the white or yellow varieties are genetically different as concerns anthocyan formation. The color change induced by γ rays is due to the deletion of chromosome matter involving the dominant gene which supposedly suppresses in natural condition the manifestation of color. The results of anthocyan examination suggest that the somatic mutations may involve dehydroxylation of the anthocyan B ring. (BBB)

33930 CLINICAL EXPERIENCE WITH ORGAN TRANSPLANTATION. Starzl, Thomas E.; Marchioro, Thomas L; Rifkind, David; Rowlands, David T. Jr.; Waddell, William R. (Univ. of Colorado, Denver). Southern Med. J., 58: 131-47 (Feb. 1965).

Homotransplantation of kidney, liver, and spleen, with the use of antimitotic drugs and ionizing radiation to suppress immune reactivity, is described. Forty-five renal homografts were used in the treatment of 42 cases. Twenty-six of the 40 patients receiving true renal homografts were alive, one month to one year postoperatively. Less successful results were obtained in five cases each of liver and spleen transplantation. (TCO)

33931 THE CHANGES OF ISOENZYMES OF LACTATE DEHYDROGENASE AFTER ACTION OF IONIZING RADIATION. PART II. ENZYMATIC AND MORPHOLOGICAL INVESTIGATIONS ON TUMOR CELL CULTURES. Kaercher, Karl Heinz; Kato, Helena Toshi; Schleich, Annelies (Universitaet, Heidelberg). Strahlentherapie, 127: 229-44 (June 1965). (In German)

The total activities of LDH and isoenzymes of the LDH were determined in explanted human tumors prior to and after irradiation. Morphological studies were done simultaneously. There was a correlation between enzyme loss by the cells and morphological changes. It is pointed out, that this combination of methods represents a useful model for clinical-radiobiological studies. (auth)

33932 INVESTIGATIONS OF THE BEHAVIOR OF WHOLE-BODY-IRRADIATED PARABIOSIS. Loehr, Eberhard (Universitaets-Strahlenklinik, Marburg, Ger.). Strahlentherapie, 127: 292-302(June 1965). (In German)

The extent of quantitative exchange of material between parabiotic partners determines the potential protective effect after radiation exposure. Angiographic results show that a fast exchange of low-molecular substances is possible between the parabionts. This confirms results which have been previously reported. The labeling of erythrocytes of one parabiont with chromium-51 resulted in only a slight increase in the activity in the other non-treated parabiont. These results suggest that an exchange of corpuscular blood elements between the pair is unlikely. The exchange seems to occur through established pathways in the lymphatic system and through diffusion events. Total body irradiation of one rat, living in parabiosis with another rat, with sublethal and lethal dosages resulted in the same survival time obtained for irradiated single animals. The irradiated parabionts exhibit a short-term increase in blood pressure amplitude. These changes were not observed in the radiation protected partner. (auth)

33933 STUDIES ON THE NITROGEN METABOLISM IN FROG LIVER AFTER WHOLE-BODY IRRADIATION. III. EFFECT OF HISTAMINE AND CYSTEINE ON NITROGEN EXCRETION FROM ISOLATED FROG LIVER AFTER WHOLE-BODY IRRADIATION. Antonijevic, Milos; Lebez, Drago (Nuclear Institute "Jozef Stefan", Ljubljana, Yugoslavia). Strahlentherapie, 127: 303-7(June 1965).

In the isolated perfused livers of whole-body irradiated frogs with 650 R (^{60}Co source) histamine improves the nitrogen balance if injected into animals before irradiation, while nitrogen catabolism is increased if histamine is administered directly into the organ after whole-body irradiation. On the other hand, cysteine injected prior to irradiation with 400 R only slightly modifies the changes in nitrogen excretion induced by irradiation. (auth)

33934 CELLULAR INTERPRETATION OF ASPECTS OF THE ACUTE MAMMALIAN RADIATION SYNDROME. Puck, Theodore T. (Univ. of Colorado Medical Center, Denver). Symp. Intern. Soc. Cell Biol., 3: 63-77(1964).

Dynamics of the radiation syndrome are examined on the basis that the principal action of radiation in the low dose range is to destroy reproduction of somatic cells. Experimental evidence is summarized showing that this process can occur with the same efficiency (within a factor of two- to four-fold) in vitro and in different regions of the body. New data and reconsideration of older phenomena are discussed demonstrating that differences in tissue response can best be interpreted primarily in terms of differences in the rates of normal tissue turnover processes. Mammalian somatic cells in vitro are exceedingly sensitive to reproductive killing by x irradiation and exhibit similar survival curves and values for D^0, the mean lethal dose for single cells, despite wide variations in the animal species, tissue of origin, and the growth rate of the cells. The survival of mammalian cells in vivo was measured for several normally differentiated and malignant tissues, and found in all cases to be very similar to the values obtained in vitro. Measurement of the initial rate of disappearance of nucleated bone marrow cells in the mouse after various doses of whole-body x irradiation showed that the rate of disappearance at first increases with dose. However, after a dose of 400 rad, which is sufficient to terminate reproduction in over 95% of the cells, the rate of cell disappearance remains constant even for doses beyond 1200 rad. Therefore, the radiation does not cause intrinsic acceleration of cell disappearance. These data support the theory that the principal action of irradiation (at least at doses below about 800 rad) is to stop cell reproduction. The differential sensitivity, with respect to cell depletion of different tissues, then reflects principally their differences in turnover rate, which causes cell removal to continue, without compensating reproduction. If the underlying assumptions are valid, these methods can be used to measure turnover number of various tissues. The generation time of the nucleated cells in the bone marrow measured in this manner was found to be about 11 hr. Evidence that the cell lesion responsible for reproductive death occurs in the chromosomes is reviewed. The great volume of mammalian chromosomes, as compared with those of bacteria, furnished a large target site for this killing action of x rays and account for the fact that the dose required is so much less for mammalian cells than for other microorganisms. (BBB)

33935 POSTNATAL MANIFESTATIONS IN ALBINO RATS CONTINUOUSLY IRRADIATED DURING PRENATAL DEVELOPMENT. Coppenger, Claude J. (San Francisco State Coll.) and Brown, Sidney O. Texas Rept. Biol. Med., 23: 45-55(1965).

The effects of continuous prenatal irradiation, at a dose rate of 50 R per day, on the growth and incidence of gross abnormalities in the maturing rat were studied. A ^{60}Co γ radiation source was used and the exposure was given at the rate of 2.5 R/hr over 20 hr/day. After total dose reached 1000 R the pregnant female rats (Holtzman strain) were removed from the radiation source. Thus the exposure was almost continuous from the first to 21st day of gestation. The average gestation period for irradiated females was 23.3 days as compared with 22.4 days for control females. There was a slight reduction in litter size, a reduction in birth weight, and decreased viability of the irradiated newborn through the first postnatal day. At the end of three months, the control males weighed considerably more than the males irradiated in utero. However, after nine weeks the average weight of the irradiated females was greater than that of the control females. At 350 days, no significant difference in body weights of the males of the two groups or of the females, was observed. There was no difference in survival between the two groups maintained for 350 days. No abnormalities appeared in the irradiated group until near the end of the 350-day period; then two of the irradiated females demonstrated advanced tumors showing extensive metastases. Weights of the liver, kidney, brain, pituitary, spleen, adrenal, and testis of the irradiated males were significantly reduced. Organ weights of

the two groups of females showed less difference. Microencephaly was observed in all of the prenatally irradiated rats. The cerebral length and width and cerebellar length were significantly reduced in the irradiated animals. The gonads of the prenatally irradiated rats were greatly reduced. The females were essentially castrates, since the ovaries were only rudimentary, detectable only by histological examination. They consisted of only a minute mass of medullary cords with no ova. All irradiated females were in a state of anestrus. All uteri were very small, the general appearance being that of a castrate female. The testes of the irradiated males were greatly reduced in size, and histologically showed well-delineated but reduced seminiferous tubules containing some cellular constituents resembling Sertoli cells but devoid of germinal cells. Intertubular spaces contained numerous Leydig cells. Normal androgen secretion was indicated in the irradiated males, since the seminal vesicles and prostates were of normal size. (BBB)

33936 INACTIVATION OF DUPONOL-TREATED TOBACCO MOSAIC VIRUS WITH RABBIT ANTISERUM. Rappaport, Irving (Univ. of Chicago); Wildman, Sam G.; Furumoto, Warren. Virology, 23: 389-93(July 1964).

A study was made of the effect of uv irradiation, ribonuclease (RNase), and antibody on the common strain of tobacco mosaic virus (TMV), Ul, partly degraded with Duponol (sodium lauryl sulfate). Infectious units surviving the detergent treatment were RNase sensitive as a consequence of having a segment of their RNA exposed. These infectious units displayed no marked change in their sensitivity to uv light or homologous rabbit antiserum, compared with intact virus, suggesting that the remaining protein coat still functioned during infection in a manner comparable to that of the intact virus. The sensitivity of the Ul strain of TMV to uv irradiation is one-fifth that of its infectious nucleic acid. This difference has been attributed to the presence of the protein coat which serves to protect the RNA. This protection is apparently still available to the degraded virus. The preparations of Duponol-treated Ul, which were reduced to 10% of original infectivity, were irradiated with a Westinghouse germicidal Sterilamp, 782L-30. Since the inactivation kinetics showed no departure from that of intact Ul, it was assumed that the infectious units of Duponol-treated Ul have a considerable functional portion of the protein coat remaining. Another preparation of Duponol-treated Ul, at 10% of its original infectivity, and specifically purified homologous rabbit antibody were incubated, and the survivors were assayed. Since Duponol treatment reduced the infectivity of TMV, the experiments were controlled by adding uv-irradiated virus to live unirradiated virus until the infectivity of virus was lowered to that of the Duponol-treated virus. The data showed no marked differences in the extent of antibody inactivation between Duponol-treated virus and untreated intact virus. The distribution of the Duponol lesions over the rod suggests that this initial virus cell contact may not be restricted to the ends of the virus but may occur at other sites as well. In addition, the data suggest that the critical antigenic sites are also distributed over the rod rather than clustered exclusively at the ends. (BBB)

33937 INDUCTION OF THE SPINAL CORD MENINGEAL TUMORS IN RABBITS WITH RADIOACTIVE COBALT. Dimant, I. N.; Loktionov, G. M.; Sataev, M. M. (Research Inst. of Roentgenology, Radiology and Oncology, Tashkent). Vopr. Onkol., 11: No. 5, 46-53(1965). (In Russian)

Granules of ^{60}Co with radioactivity of 15 microcurie were implanted in 10 rabbits under the dura mater. Spinal cord meningeal tumors occurred in three rabbits that survived 14 to 16 months. Histologically the two of these tumors proved to be fibrous and fibroblastic arachnoidendotheliomas while the third was a meningeoma of the type of sarcomatous arachnoidendothelioma. (tr-auth)

33938 EXOGENOUS MALFORMATIONS. Elsner-Mackay, P. (Landes-Frauenklinik, Wels, Austria). Wien. Klin. Wochschr., 76: 181-9(Mar. 13, 1964). (In German)

Ionizing radiation can cause malformations, such as microcephaly, microphthalmy, micrognathy, or cataract. Animal experiments have demonstrated that high doses of x irradiation or Ra exert a direct teratogenic effect on developing embryos. These are exhibited as malformations of the skull and disturbances of the central nervous system. However, much of the damage to the embryo caused by ionizing radiation is genetic, appearing in changes that develop in succeeding generations. Many of the changes caused by ionizing radiation do not appear as microscopic or structural chromosomal changes, such as alteration of the number or structure of chromosomes. Polyploidy, monosomia, trisomia, which is observed in mongolism, inversion, and fragmentation are seen frequently. These radioinduced changes help to explain, in a broad sense, that the radioinduced mutation is not a simple event that occurs immediately or irreversibly at the instant of irradiation, when the primary energy absorption takes place. Instead, it affects the very basis of the genetic factors in a significant fashion. Radiomutations are modifiable events, and depend on the developmental state of the cell or tissue, the intra- or extracellular milieu, metabolism, respiration, nucleic acid synthesis, and physical factors of dose distribution, dilution, fractionation, quality, and energy loss of the irradiation. (BBB)

33939 THE ROLE OF BLOOD CELLS IN THE PROCESS OF ASEXUAL REPRODUCTION IN THE TUNICATE PEROPHORA VIRIDIS. Freeman, G. (Univ. of Chicago). Z. Exptl. Zool., 156: 157-83(July 1964).

The possibility that, in ascidians, the lymphocyte acts as a generalized stem cell was tested. This was done by inhibiting asexual reproduction by irradiation and using these preparations as a test system. The effect of injecting different kinds of unirradiated cells into these preparations on the ability of the preparation to bud was assayed. Histological studies were also made to determine the effect of irradiation on mitotic activity and cell survival. The uptake of tritiated thymidine into DNA was used as the basis for estimating mitotic activity. Irradiation was conducted with a ^{137}Cs source of gamma rays delivered at a rate of 5000 R/min to doses up to 10,000 R. The results showed that as the radiation dose is increased, budding is inhibited, and that this inhibition is complete at a dose of 5000 R. Irradiation also inhibits the growth of these preparations. Those which received 5000 and 10,000 R showed degrowth, measured as a decrease in stolon length due to the resorption of stolon. This effect is not measurable until after the fifth day following irradiation; prior to this time all of the preparations double in length, regardless of the dose of radiation that they have received. Low doses of radiation (1000 to 2000 R) decrease the initial rate of budding, while higher doses block budding, the length of the block being dependent on the dose. After this period of inhibition there is an increase in the rate of budding, or in the cases where it has been blocked (3000 to 4000 R) it is reinitiated. As the dose of radiation is increased, the left expectancy of the initial zooid is decreased. Complete regression of all the zooids took place in preparations which received 3000 R. The 5000-R dose completely inhibited asexual reproduction. In the experiments where unirradiated blood was injected into zooid-stolon preparations which had received 5000 R of radiation, the effect of the injection on the ability of the preparation to bud was measured. This showed that 63% of the irradiated preparations injected with unirradiated blood budded, while no preparations injected with irradiated blood budded. The test preparations must be injected with whole blood not later than three days after irradiation if budding is to take place. In another experiment the blood was fractionated into the different cell classes that make it up and each cell class was tested by injecting it into an irradiated preparation. The irradiated zooid-stolon preparations received 5000 R and the injections were made the same day starting four hours after irradiation. Results of these experiments showed that only the irradiated preparations injected with lymphocytes budded. There was no indication of budding in the preparations injected with other blood cell types. There is a rough correlation between the number of lymphocytes injected and the time

when budding takes place. Studies on tritiated thymidine uptake into normal animals indicate that the lymphocyte has a much higher rate of cell division than the other cell types of the blood. This observation provides a rationale for explaining the differential sensitivity of the lymphocytes to irradiation. The lymphocyte cell class can also be be divided into two sub-classes on the basis of cell size. The smaller lymphocytes have a greater capacity to initiate budding in irradiated preparations than the larger lymphocytes. (BBB)

33940 THE DETECTION OF SIDEROCYTES IN PERIPHERAL BLOOD AFTER WHOLE-BODY X IRRADIATION OF RATS. Brueschke, Gerhard (Universitats-Klinik der Charite, Berlin). Z. Ges. Inn. Med. Ihre Grenzgebiete, 19: 227-8(Mar. 1, 1964). (In German)

Previous studies have indicated that after irradiation serum Fe increases. This is accompanied by a parallel increase of sideroblasts in the bone marrow. The siderogram shows a shift to the right, suggesting destruction of bone marrow activity. In order to ascertain whether siderocytes increased in peripheral blood after whole-body x irradiation one group of adult rats was irradiated a single time with either 1200, 1400, 1600, or 1800 R. A second series of rats was given whole-body irradiation at the rate of 100 R daily. Increased concentrations of siderocytes were detected in the peripheral blood after these treatments, but in many cases this observation was not definite. Additional studies will be required to confirm this effect, or to explain it. (BBB)

33941 AUTORADIOGRAPHIC STUDIES OF THE DISTRIBUTION OF ^{14}C-NITROGEN MUSTARD-LABELLED CYCLOPHOSPHAMIDE IN IRRADIATED AND NON-IRRADIATED TRANSPLANTED TUMORS (YOSHIDA-SARCOMA). Kallenbach, H.-H.; Schuster, R.; Gregl, A. (Universitet, Gottingen, Ger.). Z. Krebsforsch., 66: 218-24(1964).

The distribution of ^{14}C-nitrogen mustard-labeled cyclophosphamide in irradiated and non-irradiated transplanted tumors (Yoshida sarcoma), was studied autoradiographically in the rat. It was shown that this radioactive material was selectively taken up by the tumor tissue; and in the peripheral regions in higher concentrations than in necrotic regions. Irradiated tumors showed a similar distribution of activity, but the peripheral regions of the tumor because of the irradiation-induced tissue changes, contained less radioactive material than the non-irradiated tumors. (Excerpta Med.)

33942 INFLUENCE OF ACUTE BLOOD LOSS ON TUMOR INCIDENCE IN WHOLE-BODY X-IRRADIATED RATS. Reincke, U.; Hunstein, W.; Stutz, E. (Universitat, Freiburg, i.B.). Z. Krebsforsch., 66: 379-88(1964). (In German)

Male and female Wistar rats were irradiated with a single 270-R dose of 180-kv x rays. One group of irradiated rats had been bled (2-ml blood loss) two days earlier to investigate the role of hyperactivity of the hematopoietic system on tumors arising from irradiation. Incidence of tumors was greater in the group subjected to preirradiation bleeding. Thus in this group 121 tumors developed in 101 animals compared with 90 tumors in 98 irradiated rats and 39 tumors in 108 untreated controls. Benign tumors, especially of mammary glands and uterus, were higher in females of both irradiated groups, as compared with males, and irradiation caused a further increase in their incidence. Evidently, irradiation enhances neoplasia in tissues which have a high proliferation rate. A pronounced increase of adenomas of endocrine glands occurred after irradiation plus blood loss. These included one adrenal, three pancreatic islet-cell, and seven hypophyseal tumors in this group. The comparative incidence of tumors in the various groups (irradiation-blood loss, irradiation only, untreated) was as follows: tumors of all locations, males 46.7, 30.2, 5.1%; females 89.3, 88.9, 39.2%; genital tumors, males 6.7, 1.9, 2.6%; females 73.2, 86.7, 31.6%; nongenital, males 42.2, 30.2, 2.6%; females 42.9, 28.9, 11.4 %. These data show that the nongenital tumors accounted for most of the higher tumor incidence in the irradiated animals. An evaluation of the effect of blood loss on tumorigenesis shows a significant relation only in the male animals, in which it is postulated as having a promoting effect on radiation-induced tumor formation. (BBB)

33943 ON THE FREQUENTLY OCCURRING TRISOMIC PLANTS IN THE DESCENDENTS OF DIPLOID X-RAY MUTANTS IN OENOTHERA BERTERIANA. Arnold, Carl-Gerold; Kressel, Maria (Universitaet, Erlangen-Nuernberg, Ger.). Z. Vererbungslehre, 96: 83-92(1965). (In German).

Results of experiments begun 6 yr ago when seeds of Oenothera berteriana were exposed to various doses of x rays are reported. The X_1 generation plants showed numerous deviant types, but nearly all had the normal chromosome number (2n = 14). In the next year the X_2 plants were grown and most were found to have an abnormal chromosome complement, the most frequent being 15-chromosome types as well as trisomic mutants. Thus in the progeny of radio-induced diploid X_1 variants of O. berteriana, trisomic mutants were found frequently. Studies were designed to elucidate the cause of this phenomenon. In these X_1 variants, deviating diakinesis configurations attributable to radioinduced translocations were observed frequently. For example, instead of the normal 14-chromosome ring, two rings were often found, both rings being even-numbered or both odd-numbered. The X_1 mutants with odd-numbered diakinesis rings are chiefly responsible for the segregation of trisomic plants in the X_2. For in this instance, as a consequence of quite normal chromosome distribution in the anaphase, a quarter of all genes receive n + 1 chromosomes. After combination with normal n-pollen, 2n + 1 plants are obtained. Thus in this case trisomic plants are formed without usual spontaneous nondisjunction. To a lesser degree, plants with deviating chromosome numbers were also found in the progeny of X_1 mutants which had even-numbered diakinesis rings. The occurrence of such plants is attributable to nondisjunction, which is evidently furthered by radiation-damaged chromosomes; however, the reasons for the frequent occurrence of nondisjunction in radioinduced mutants are not entirely clear. (BBB)

33944 THE INFLUENCE OF EXTRACELLULAR UV IRRADIATION OF T2 PHAGE ON THE REPLICATION OF ITS DNA. I. THE KINETICS OF DNA SYNTHESIS IN MULTIPLICITY REACTIVATION. Koelsch, Eckehart (Universitaet, Cologne). Z. Vererbungslehre, 96: 168-74 (1965). (In German)

The effects of extracellular uv irradiation on the replication of DNA were tested with phage T2. Cells of Escherichia coli B/1 were multiply infected with uv-irradiated T2. The kinetics of ^{32}P incorporated into phage DNA was significantly different from the unirradiated control. With unirradiated phage the ^{32}P incorporation vs time curve is linear during the second half of the latent period after a short nonlinear increase. With uv irradiated phage, however, the amount of DNA increases exponentially during the whole latent period. Such kinetics might be expected from semiconservative DNA replication if templates were limiting. The findings suggest that other regulatory mechanisms normally limiting DNA synthesis are inactivated by uv. The kinetics determined by semiconservative replication could then be clearly observed with irradiated phages. The nature of the normally regulating mechanisms is discussed. One possibility considered is that after uv irradiation, altered kinetics of DNA synthesis does not have its origin primarily in increased enzyme synthesis but that the altered kinetics of DNA and enzyme synthesis is only an expression of changes in regulation of cell metabolism. (BBB)

33945 PROTECTIVE VACCINATION OF MONKEYS AGAINST GAS GANGRENE CAUSED BY Cl. PERFRINGENS IN CONDITIONS OF CHRONIC IRRADIATION. Dzhikidze, E. K.; Aksenova, A. S. Zh. Mikrobiol, Epidemiol. i Immunobiol., No. 1, 132-7(Jan. 1963). (In Russian)

Experiments were carried out on 24 monkeys (Macacus rhesus) fifteen of which were subjected to daily irradiation doses of 1.17 to 1.34 R (^{60}Co γ rays) for 18 to 20 months. Nine to twelve months later, 9 of 15 monkeys were immu-

nized with sorbed gangrene-tetanus tritoxoid injected twice at intervals of one month in 1 ml doses. The animals were revaccinated in 6 months. In artificial Clostridium perfringens infection of 6 irradiated monkeys and 6 controls, it was established that prolonged irradiation with low doses (up to a total dose of 519 R) caused no increase in sensitivity to gas gangrene. Investigation of the artifically acquired immunity in experiments with direct infection showed that prophylactic vaccination during chronic irradiation (total doses of 519 and 600 R) was effective, causing the development of active immunity and preventing the death of infected animals. (TCO)

33946 ON THE EFFECT OF CHRONIC IRRADIATION WITH LOW RADIATION DOSES ON THE BODY RESISTANCE TO INFECTION. Erlikhman, G. I. Zh. Mikrobiol, Epidemiol. i Immunobiol., No. 3, 64-8(Mar. 1963). (In Russian)

Young albino mice were subjected to low doses of gamma-rays during their growth. The offspring of these mice were irradiated during intrauterine development. A study was made of the immunity of the animals to the S. typhimurium infection at different periods after the irradiation was discontinued. Immunity was reduced in mice irradiated in daily doses of 2 R and infected immediately after irradiation. Such losses of immunological competence were not found in the controls. (TCO)

33947 IMMUNOGENESIS PECULIARITIES IN GUINEA PIGS IMMUNIZED WITH SORBED TETANUS TOXOID IN CONDITIONS OF IONIZING RADIATION INJURY. Ilyutovich, A. Yu.; Raikis, B. N.; Labetskii, I. I. Zh. Mikrobiol, Epidemiol. i Immunobiol., No. 7, 61-4(July 1963). (In Russian)

A study was made of immunological reconstruction in irradiated guinea pigs by determining the dynamics of the antitoxin titre rise in the blood and cytomorphological changes in the regional lymph nodes. The animals were subjected to a single whole-body dose of x-rays. Radiation reduced antibody levels in the blood, and inhibited the transformation of reticular cells into plasmatic ones. (TCO)

33948 IMMUNIZATION OF IRRADIATED CITELLUS SUSLICA GUELDENSTAEDT WITH PENICILLIN AND PENICILLINALUM LEPTOSPIRA VACCINE. Morozova, V. P. Zh. Mikrobiol. Epidemiol. i Immunobiol., No. 7, 64-8(July 1963). (In Russian)

Immunization of Citellus suslica Gueldenstaedt with absorbed leptospira vaccine two to 10 days prior to irradiation, on the day of irradiation, and two and 10 days afterwards led to development of specific immunity of sufficient intensity. Immunization conducted at the same periods and under the same conditions with a nonadsorbed vaccine either did not produce any immunity or immunity of a much lower intensity. (TCO)

33949 INDUCTION WITH ULTRAVIOLET RAYS OF THE COLICIN SYNTHESIS BY E. COLI. Likhodied, V. G. Zh. Mikrobiol, Epidemiol. i Immunobiol., No. 7, 116-20(July 1963). (In Russian)

A study was made of colicin synthesis induction after ultraviolet irradiation of various E. coli strains. Colicin synthesis increased considerably in some strains following irradiation. Induced colicin synthesis started after the period of residual bacterial growth and was accompanied by their mass death in the absence of visible lysis. Synthesis was induced in all strains producing B and D colicins. Strains producing colicins G, H, I, or V had no induction capacity. It was suggested that the type of colicin produced by a given strain influences the ability of the strain to induce synthesis. (TCO)

33950 THE VIRULENCE OF B. BRESLAU IN MICE SUBJECTED TO X-IRRADIATION. Kalashnikova, G. K. Zh. Mikrobiol, Epidemiol. i Immunobiol., No. 8, 68-71 (Aug. 1963). (In Russian)

The effects of radiation on severity of infectious processes were studied in x-irradiated mice infected with B. breslau. Virulence of the pathogen was determined in organisms isolated from organs of experimental and control animals and compared to that of organisms from the original culture. It was concluded that irradiation did not produce significant changes in B. breslau virulence. The infectious process was stimulated by reduction in body resistance followed by turbulent bacterial multiplication. (H.G.D.)

33951 THE EFFECT OF RADIOACTIVE AGENTS ON THE SURVIVAL AND PROPERTIES OF TYPHOID BACILLI. Zhogova, V. M. Zh. Mikrobiol, Epidemiol. i Immunobiol., No. 8, 71-6(Aug. 1963). (In Russian)

Polonium-210 in a concentrations of 2.10^{-3} to 2.10^{-4} curie per liter and strontium-90 in a concentraction of 2.10^{-2} curie per liter had bactericidal effects on suspensions of typhoid bacilli. In lower concentractions mortality of bacteria was more rapid than in controls. Bacterial survival was higher in thicker initial suspensions. The presence of radioisotopes in the tested concentrations had no significant effect on cultural, morphological, and biochemical properties. Nor was the antibiotic-sensitivity of the typhoid bacilli effected. (TCO)

33952 ON THE ORDER OF INCLUSION OF VARIOUS ORGANS INTO IMMUNOGENESIS IN ACUTE RADIATION SICKNESS. Ravich-Scherbo, M. I.; Prokopenko, L. G. Zh. Mikrobiol, Epidemiol. i Immunobiol., No. 10, 5-11 (Oct. 1963). (In Russian)

The order of inclusion of various organs into immunogenesis is the same in healthy and irradiated animals. Following the first injection of corpuscular and soluble antigens, antibody formation took place only in the regional lymph nodes. Repeated stimulation with corpuscular antigen caused generalization of immunological response. Following double immunization with the soluble antigen, immunogenesis was still limited to the regional lymphoid apparatus. Soluble antigen sorbed on homologous erythrocytes proved to be immunologically more effective for the irradiated organism than the crude antigen. (auth)

33953 IN SEARCH OF THE METHODS USED FOR STIMULATION OF LEPTOSPIROSIS IMMUNITY IN IRRADIATED ANIMALS. Morozova, V. P. Zh. Mikrobiol, Epidemiol, i Immunobiol., No. 10, 75-80(Oct. 1963). (In Russian)

Evidence is presented suggesting that antibody synthesis is stimulated and survival increased in irradiated rabbits shielded abdominally and vaccinated with sorbed vaccine. Large doses of heterogenic serum administered prior to irradiation depressed antibody production in response to the post-irradiation antigen challenge. Low serum doses had the same effect on antibody synthesis, at the same time failing to increase radioresistance. Abdominal shielding increased survival in infected animals. (H.G.D.)

33954 ROL' FUNKTSIONAL'NOI NAGRUZKI V LOKALIZATSII LUCHEVOGO PORAZHENIYA. (The Role of the Functional Load in Localization of Radiation Injury). Sokolova, N. V. Tomsk, [USSR], Izdatel'stvo Tomskogo Universiteta, 1962. 162p.

An extensive review is given of published data on pathomorphology of radiation injuries of certain organs and the effect of functional load on the course and morphology of radiation injuries. An analysis was made of morphological characteristics of radiation injuries in kidneys, liver, spine marrow, and skeletal muscles as functions of intensity and functional load at the moment of exposure. The observations were carried out in conditions of radiation injuries induced by a single exposure. 589 references. (R.V.J.)

33955 SOME RESULTS OF STUDIES CARRIED OUT AT THE INSTITUTE OF RADIATION BREEDING IN 1962. Nishida, Teruo (Inst. of Radiation Breeding, M.A.F., Ohmiya, Japan). p.79-92 of "Cell Differentiation and Somatic Mutation." Ohmiya, Japan, The Institute of Radiation Breeding, Ministry of Agriculture and Forestry, 1963.

Results are summarized from a series of experiments on the radiosensitivity of various plants, the effects of environmental and physiological factors on radiosensitivity, and changes in the radiosensitivity of plants irradiated at

different growth stages under chronic and semi-acute γ exposures. Many annual plants completed their whole life in a γ radiation field and many perennial plants passed one growth cycle in the γ field. The plants were arranged in concentric circles around a ^{60}Co source. Data are presented on the effects of chronic γ exposure on the morphology and physiology of rice (Oryza sativa); maize (Zea mays); potato (Solanum tuberosum); soybeans (Glycine max); vegetables of the Solanaceae, Cucurbitaceae, and Leguminosae families including pepper, tomato, egg plant, melons, cucumber, squash, peas, and string beans; forest trees including Japanese cedar (Cryptomeria japonica), Japanese black pine (Pinus Thunbergii), Japanese cypress (Chamaecyparis obtusa and Chamaecyparis pisifera), Japanese larch (Larix leptolepis), alders (Alnus spp.), oak (Quercus acutissima), paulow (Paulownia tomentosa), and poplar (Populus spp.); mulberry trees (Morus bombycis, M. alba, and M. latiforia); tea plants (Thea sinensis); fruit trees including peaches (Prunus persica), apples (Malus pumila), Japanese persimmons (Diospyros spp.), pears (Pyrus serotina), oranges (Citrus unshu, C. natsudaidai, C. tamurona, and C. hassaku); and grapes (Vitis labrusca and V. vinifera). Data are included on the effect of γ radiation on the growth and fertility of plants irradiated at different growth stages under semi-acute γ doses. Results are included from studies on soybeans (Tachisuzunari and Shinmerjiro var.), tomatoes, Chinese cabbage. Preliminary results are included from studies on the effects of environmental and physiological factors on radiosensitivity of rice and forest trees. (C.H.)

33956 RADIATION EFFECTS IN PLANTS AND SEEDS. p.202-21 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Research programs on radiation effects in plants and seeds are reviewed. Results are summarized from laboratory and field studies using seeds, whole plants, or plant parts, and studies on the effects of radiation in a natural environment using multiple species and complex physical and biological interactions. Data are included on the effects of chromosome number and volume on radiosensitivity of different species of higher plants; factors affecting the radiosensitivity of seed; the effects of x or γ radiation on growth and differentiation of plants; the genetic effects of radiation in plants; point mutation studies in maize and barley; radiation effects on forest trees; and the effects of underground nuclear detonations on vegetation of the Nevada Test Site. (C.H.)

33957 MAMMALIAN GENETICS. p.221-36 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

The genetics research program includes studies of both basic genetics and radiation genetics, with emphasis on the estimation of genetic hazards of radiation in man. Since information required cannot be obtained by direct experimentation with man himself, data on other mammals are used. Results are summarized from studies of radioinduced mutations in mice; tissue culture studies on the role of the x chromosomes in cell metabolism; chromosome pattern studies in human leukocytes grown in culture medium in which tritiated thymidine and autoradiography were used to study DNA synthesis; species differences in the radiosensitivity of oöcytes; the correlation of blood groups with diseases in human populations; and studies of variant alleles in mice. (C.H.)

Radiation Effects Therapy and Countermeasures

33958 (ORNL-P-1446) THE IMPORTANCE OF DOSIMETRY TO THE MEDICAL MANAGEMENT OF PERSONS ACCIDENTALLY EXPOSED TO HIGH LEVELS OF RADIATION. Andrews, Gould A.; Auxier, John A.; Lushbaugh, C. C. (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 14p. (CONF-650302-22). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From IAEA Symposium on Personnel Dosimetry for Accidental High-Level Exposure to External and Internal Radiation, Vienna.

The medical management of persons accidentally exposed to high levels of penetrating whole-body irradiation from an external source is discussed. The clinical manifestations of radiation injury in man are reviewed on the basis of available data on persons exposed accidentally or clinically for purposes of marrow grafts. Effective therapy is available for management of patients exposed in the LD_{50} range but little can be done for those who have received doses in the supralethal range. The importance of dosimetry is stressed but experience has shown that in all radiation accidents important information has been lost in the excitement of the situation. Biological manifestations and laboratory tests of value in establishing the radiation dose are outlined and the treatment of various levels of radiation injuries is discussed. (C.H.)

33959 THE EFFECT OF TOPICAL ESTROGEN ON IRRADIATED VAGINAL EPITHELIUM. Pitkin, R. M.; Bradbury, J. T. (State Univ. of Iowa Hospitals, Iowa City). Am. J. Obstet. Gynecol., 92: 175-82(May 15, 1965).

Forty-nine patients previously treated with conventional radiotherapy for cervical carcinoma depth dose of 4000 R gamma or x-rays to the midpelvis followed by 6480 mg-hr Ra were given a cream containing 0.01% dienestrol (an estrogen compound) or an identical cream base containing no estrogenic substance three times weekly. Three months later vaginal smears and biopsies were repeated. In the estrogen-treated cases the thickness and maturation of the epithelium were observed to increase progressively. The epithelial covering became progressively more complete and there was maturation into the spinous layer. After two years had elapsed postirradiation the epithelium assumed a more nearly normal structure, although in no instance was a fully developed stratified squamous epithelium observed. Inflammatory changes in the stroma gradually diminished in a manner roughly reciprocal to the epithelial changes. A similar but less dramatic response was noted in the gross appearance of the cervix and upper vagina. Pale atrophic-appearing epithelium became pinker and there was a decrease in the number of telangiectases and in the amount of contact bleeding. Results with placebo medication indicated that the effect was due to estrogen. The promotion of epithelial maturation with topical estrogen appeared to be somewhat less in patients immediately postirradiation than in those in whom three or more months had elapsed since radiation. Presumably, in the immediate postradiation period acute radiation changes predominate while later purely atrophic effects as a result of castration become more prominent. (TCO)

33960 EFFECT OF CERTAIN PURINE AND PYRIMIDINE ANALOGUES ON GROWTH, NUCLEIC ACID SYNTHESIS AND ULTRAVIOLET-INDUCED LYSIS IN VIBRIO CHOLERAE. Kapoor, N. K.; Sagar, P.; Agarwala, S. C. (Central Drug Research Inst., Lucknow, India). Biochim. Biophys. Acta, 103: 120-6(May 11, 1965).

Whereas 6-azathymine and 8-azaguanine showed very little action either on growth or on the synthesis of RNA and DNA in Vibrio cholerae, 6-azauracil brought about a pronounced inhibition of these functions and that of protein synthesis. Furthermore, 6-azauracil alone was capable of protecting the cells against ultraviolet irradiation-induced lysis. Both the inhibitory responses as well as its protective action against lysis were reversed by uracil, suggesting thereby that such lysis involves elaboration of some lytic principle, the synthesis of which is dependent on the prior, or concurrent, formation of nucleic acids. (auth)

33961 STUDIES ON THE EFFECTS OF IRRADIATION OF CELLULAR PARTICULATES. V. ACCELERATION OF RECOVERY OF PHOSPHORYLATION BY POLYANIONS. Yost, H. T. Jr.; Richmond, S. S.; Beck, L. H. (Amherst Coll., Mass.). Biol. Bull., 127: 526-37(1964).

Male rats exposed to 800 R gamma radiation were in-

jected post-irradiation with various polyanions and polycations and with a cell-free extract of rat spleen. Inactivation of oxidative phosphorylation by the irradiation was reversed by the spleen extract and by the polyanions, but not by the polycations. The data suggest that one of the functions (and possibly the only function) of cell-free extracts derived from spleen tissue is the restoration of oxidative phosphorylation in irradiated organisms. Since this effect can be duplicated by any of several commercially prepared polyanions, it seems unlikely that the spleen has in it a special agent responsible for effecting radiation protection. The data obtained with oxidative phosphorylation are in no way contradictory to the cellular replacement hypothesis of increased survival after exposure to radiation; they merely explain a possible mode of action of humoral agents which are known to have a limited effect on survival. Failure of PES to increase survival under the same conditions in which it recouples phosphorylation would seem to indicate that survival and regeneration of the phosphorylation mechanism are independent processes. (Excerpta Med.)

33962 ON THE RADIOPROTECTIVE POWER OF SOME ORGANOPHOSPHORUS COMPOUNDS. Cheymol, J.; Chabrier, P.; Adolphe, M.; Hetiz, F. (Faculte de Medecine Paris). Bull. Acad. Natl. Med. (Paris), 673-8(Dec. 3-10, 1963). (In French)

Twelve trisubstituted derivatives of orthophosphoric acid were studied. Eleven have two methoxy or thiomethoxy groups; the variation in the third substituent has a great effect on toxicity. Female mice aged 7 to 8 weeks were exposed to a 750-R dose; a new apparatus for handling the animals during irradiation is described and illustrated. The animals were irradiated in groups of ten, five of which were controls; for each compound a total of 50 were studied. A table is given for results of the toxicity, radioprotective action, and anticholinesterase activity for the following compounds: $(CH_3O)_3PSe$; $(CH_3O)_2P(S)SCH_2CONHCH_3$; (CH_3) $(CH_3O)P(O)$ $OCH_2COOC_2H_5$; (CH_3S) $(C_2H_5O)P(O)O(2,4\text{-}Cl_2C_6H_3)$; $(CH_3O_2)P(O)$ $SCH_2(4\text{-}O_2NC_6H_4)$; $(CH_3O)_2P(O)SeCH_2\text{-}CO(N\text{-}morpholine)$; $(CH_3O)_2P(O)SCH(COOC_2H_5)_2$; $(CH_3O)_2P\text{-}(O)O(3\text{-}CH_3\text{-}4\text{-}O_2NC_6H_3)$; $(CH_3O)(CH_3S)P(O)O(4\text{-}O_2NC_6H_4)$; $(CH_3O)(CH_3S)P(O)O(3\text{-}CH_3\text{-}4\text{-}O_2NC_6H_4)$ $(CH_3O)(CH_3S)P\text{-}(O)SCH(CH_2COOC_2H_5)$ $(COOC_2H_5)$; and $(CH_3S)_3PO$. Of these only the fourth and the seventh had radioprotective action. The intraperitoneal LD_{50} for these were 300 and 77 mg/kg respectively; therapeutic doses were 150 and 38 mg/kg; % surviving on 30th day were 24 and 18; anticholesterase activities were 1.5 and 0.32 μg/ml. (BBB)

33963 MECHANISM OF THE INCREASE IN RADIORESISTANCE IN THE LACTOPROPHYLAXIS OF ACUTE RADIATION SICKNESS. Raeva, N. V.; Klemparskaya, N. N. Bull. Exptl. Biol. Med. (USSR) (English Transl.), 58: 800-3(July 1964). Translated from Byul. Eksperim. Biol. i Med., 58: 44-8(July 1964).

The role of autosensitization in the pathogenesis of radiation sickness is discussed. Results are reported from studies on the radioresistance of animals injected with sterile milk before exposure to radiation. The experiments were conducted on 64 guinea pigs and 30 dogs irradiated with ^{60}Co γ rays on an EGO-2 apparatus at a dose rate of 245 to 248 R/min (over a period of 70 to 82 sec). Data are presented on the influence of injection of various quantities of milk two weeks before irradiation on the survival rate among guinea pigs and dogs of different batches and different mean weights, with different irradiation doses employed. A dose of 300 R proved absolutely lethal for the control guinea pigs which were injected with physiological solution, and for the animals which received 0.5 ml of milk. When the milk dose was increased to 1.5 ml one guinea pig survived, when this dose was doubled two of the six animals were protected. In the second experiment, which was conducted on younger guinea pigs, the irradiation dose was reduced to 250 R and this led to the development of a mild form of radiation sickness. Only 3 of the 10 control guinea pigs died, while only 2 of the 30 which received milk succumbed. Statistical processing of the data on the survival rate among the guinea pigs which received a sufficient milk dose (1.5 to 5 ml) showed a reliable difference from the control group. In addition to the number of animals which died, another index of the severity of the radiation sickness is the change in their weight. By the 18th day there was a drop of 5 g in mean weight in the control group, while the mean weight in the experimental group rose by 7 to 22 g. By the 30th day the gain in weight for the experimental guinea pigs amounted to 50 to 56 g, while the weight of the control animals which survived remained at its previous level. The dogs were given one or two subcutaneous or intramuscular injections of milk in a dose of 0.5 to 1 ml per kg of body weight before irradiation. The interval between the 1st and 2nd injections was 3 to 4 days, while the interval between the 1st injection and the irradiation differed, 4, 7, 30, and 40 days being employed. The irradiation dose was 300 to 350 R. A total of 30 mongrel dogs weighing from 6 to 25 kg were used in the experiment, receiving the usual vivarium diet. Twenty dogs were given milk before irradiation: 10 of these received no treatment after irradiation. The dogs inoculated with milk showed no signs of radiation sickness immediately after irradiation while 50% of the control group became seriously ill. Late symptoms of radiation sickness developed in the dogs given milk injections but the symptoms were mild. (C.H.)

33964 THE USE OF PRESERVED HEMATOPOIETIC TISSUES FOR TREATMENT OF MICE LETHALLY IRRADIATED WITH GAMMA-RAYS UNDER HIGH DOSE RATE. I. EFFECT OF PRESERVED ISOLOGOUS BONE MARROW. Hama, Masaharu (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 43: 64-93(Jan. 1965).

Mice were irradiated lethally with gamma rays under high dose rate and were treated with preserved isologous bone marrow. The isologous bone marrow cells were suspended in 15 vol % glycerol-Tyrode's solution at −80°C for as long as 450 days. At 30 days after irradiation, the isologous bone marrow, within 360 days preservation, protected the lethally irradiated mice as well as the fresh isologous bone marrow transplantation did. As many as 5 million nucleated cells were injected. (auth)

33965 OBSERVATIONS ON THE RADIOPROTECTIVE ACTION OF S-(2-AMINOETHYL)ISOTHIURONIUM (AET) AND OF ITS DERIVATIVES IN BACTERIA. Masironi, R. (Universita, Rome). Farmaco (Pavia) Ed. Sci., 18: 614-18 (Aug. 1963). (In Italian)

The radioprotective action of AET and related compounds on bacteria was investigated. AET, at a concentration of 10^{-3}M, was added to broth cultures of Staphylococcus aureus exposed for 10 min to 12.5 kR/min of 75-kv x rays. After irradiation, AET-treated and control cultures were used to inoculate broth cultures, the turbidities of which were followed up to 18 hr after irradiation. AET alone was not toxic for staphylococci, and in irradiated cultures conferred partial protection as shown by a growth curve intermediate between control and irradiated unprotected cultures. In these experiments, AET was added to the cultures 10 min before irradiation; however, 20-min exposure of the bacteria to AET revealed toxicity. AET at 10^{-3}M was also found to protect staphylocci exposed to β radiation at ^3H_2O, at a sp act. of 41.6 mC/ml, but in this case AET showed some toxicity to the microörganisms. To avoid this problem, some derivatives of AET were tested for radioprotection in the absence of toxicity. Various isothiuronic acid derivatives were synthesized, the most interesting one being S-2(7-N-theophyllin)ethylisothiuronium (TET). TET showed no toxicity to bacteria at a concentration of 0.3×10^{-2}M and good radioprotection activity; in fact, comparable to that of cystamine on an equimolar basis. Staphylococci exposed to ^3H_2O, so that growth was completely blocked, showed appreciable growth in the presence of TET or cystamine, neither compound causing toxicity. Analogous results were obtained with thiuronic acid derivatives in which the amine N atom is completely substituted. These compounds have also been successfully tested on Allium cepa in ^3H_2O. Although AET revealed toxicity in prolonged contact with this and other biological materials, another derivative, amino-β-tris(S-ethylisothiuronium) (ATET) had practically no toxicity but good radioprotective activity.

The results demonstrating radioprotection with TET are in conflict with the intratransguanylation concept whereby the radioprotection afforded by AET derivatives results from an intramolecular rearrangement in vivo or in vitro leading to formation of mercapto-(N-alkyl) guanidine. This provides a free SH group, which was said to confer radioprotection. In TET, such an intramolecular rearrangement cannot occur to provide a free SH group. The possibility that in vivo enzymic activity may liberate SH groups in these compounds is suggested. (BBB)

33966 RISE IN THE RESISTANCE OF ANIMALS AGAINST RADIATION BY ARTIFICIALLY INCREASING THE BLOOD SUGAR. Tsetkova, V. V. (Kharkov Medical Inst.). Fiziol. Zh., Akad. Nauk Ukr. RSR, 10: 818-20(Nov.-Dec. 1964). (In Ukrainian)

Seventy five mature male rats were exposed to up to 500 R of x radiation at a dose rate of 41.6 R/minute. One group of the animals which weighed between 175 and 200 g, were treated with butamid at the rate of 100 mg/kg and with alloxan at the rate of 125 mg/kg body weight, in order to determine the pharmacological effects of these factors on the blood. Under the conditions of the alloxan-induced hyperglycemia, a larger fraction of the irradiated animals survived in the group that was not first treated with butamid; this latter agent inhibits the rise of the blood concentration of the animals. This increased radiation resistance during hyperglycemia indicates that it might be possible to make use of such an artificial increase of the blood sugar as a prophylactic measure in cases of radiation sickness. (TTT)

33967 RESTORATION FROM RADIATION DAMAGE WITH NUCLEOTIDE MIXTURES IN MICE. Sugahara, T.; Tanaka, T.; Nagata, H. (Kyoto Univ.). Folia Biol. Prague, 10: 461-4(1964).

Restorative effects of the mixtures of 3′(2′)- or 5′-ribosemononucleotides from RNA were studied in irradiated mice. Survival time for repeated irradiations in mice and reproductive capacity of irradiated bone marrow cells in the spleen of heavily irradiated recipient mice were used as test systems. The mixtures were administered after the start of irradiation. A significant increase in survival time of mice and cell reproductivity were observed with 3′(2′)-nucleotides but not so with 5′-nucleotides. The mechanisms of the effects and their differences are discussed. (Excerpta Med.)

33968 EFFECT OF GIBBERELLIC ACID ON THE SUBSEQUENT GROWTH OF GAMMA-IRRADIATED MAIZE SEEDS. Gaur, B. K.; Notani, N. K. (Atomic Energy Establishment, Trombay, India). Indian J. Plant Physiol., 6: 118-22(1963).

The effect of post-irradiation treatment of seeds with gibberellic acid (GA) was studied on the subsequent growth of roots, root-hair and coleoptile. Increasing doses of gamma-radiation (0 to 162 kR) gave progressively more inhibition of growth for all the plant parts studied. Root-hair, although most radiosensitive, showed little response to GA. The next in order of decreasing radiosensitivity were primary root, seminal roots and coleoptile, there being no further decrease in growth beyond a certain dose depending on the part concerned. Ga did bring about partial stimulation of growth of roots and coleoptile in controls and irradiated plants. Interestingly enough, the response to GA remained more or less the same for all radiation doses except at the highest dose. The role of GA, if any, in the reversal of radiation induced growth inhibition is discussed. (auth)

33969 THE EFFECT UPON MICROCOCCUS VIOLAGABRIELLAE OF SHORT-TERM EXPOSURE TO ULTRAVIOLET LIGHT. Payne, J. I.; Campbell, J. N. (Univ. of Alberta, Edmonton). J. Gen. Microbiol., 38: 343-56(Mar. 1965).

The significance of bacterial pigments as radiation-protective agents was investigated. The presence of ferric and/or ferrous ions in growth media induces the production of a reddish-violet pigment in the otherwise white bacterium M. violagabriellae, and this alteration of pigment production in this organism without the complications of mutation thus provides a unique system for the study of the effects of the presence or absence of pigment on sensitivity to radiation. Thus this system was used to compare the effects of uv irradiation on red-pigmented and white organisms in the expectation that such a comparison might furnish information about the site of irradiation damage. The pigment protected the organism against short exposures to uv radiation of wavelength below 300 mμ. The presence of iron also increased the degree of recovery of the normally white organism after uv irradiation. Anaerobic growth rendered both the red and white micrococci more resistant to damage by uv radiation. However, the addition of nitrate, an alternative to oxygen as a terminal electron acceptor, restored the uv sensitivity of these micrococci to that of aerobically grown organisms. It is suggested that the initial site of uv irradiation damage is extranuclear and involves one or more cytochrome-linked systems, and that it is within this system(s) that the iron functions both as a radiation-protective and as a restorative agent. The results from the use of the inhibitors favor this interpretation. For micrococci growing in the absence of iron, hence not synthesizing red pigment, glutathione had no effect on sensitivity to uv radiation which suggests that a sulfhydryl system was not involved. o-Cresol similarly had no effect on nonpigmented micrococci. Both of these substances can affect sensitivity to uv radiation only under conditions where their presence depresses the amount of pigment synthesized, and hence the amount of iron complexed by the organisms. Ascorbic acid decreased the sensitivity of the micrococci to uv radiation and, since it is a reducing agent, perhaps it protected an oxidation-reduction system. (BBB)

33970 INFLUENCE OF DIMETHYL SULFOXIDE ON THE RADIATION SENSITIVITY OF CATALASE. Lohmann, W.; Moss, A. J. Jr.; Perkins, W. H. (Univ. of Arkansas and VA Southern Research Support Center, Little Rock). J. Nucl. Med., 6: 519-23(July 1965.

The change in radiosensitivity of catalase by dimethyl sulfoxide (DMSO) was investigated spectrophotometrically. The enzyme-DMSO mixtures were irradiated with different doses of x-rays (0. to 2.25×10^6 R) at room temperature. The results obtained show that DMSO provides a good radioprotective effect. This protective effect might be explained by a complex formation between Fe^{3+}, the active site in catalase, and the protective compound. The existence of such a complex was shown by electron spin resonance and optical absorption studied. Both the variation in line width (ESR spectra) and the optical red shift obtained suggest a change in crystal-field energy levels by spin-orbit mechanisms. (auth)

33971 RADIATION-PROTECTION OF SERRATIA MARCESCENS BY A THIOSULPHONATE RELATED TO CYSTEAMINE. Owen, T. C. (Univ. of South Florida, Tampa); Parker, M. S.; Stern, G. M. J. Pharm. Pharmacol., 17: 108-14(Feb. 1965).

This x-irradiated microorganism was used to study the radioprotective properties of a thiosulfonate, 2-aminoethyl 2-amino-ethanethiosulfonate (also known as cystamine disulfoxide). Testing in organisms at a pH (4.5 or below) where the thiosulfonate would be stable is impossible in higher organisms where close maintenance of neutrality (pH 7) is essential to survival. Thus as a test organism, the red pigmented bacterium S. marcescens was chosen, permitting examination of the thiosulfonate at pH 4.5 where it is stable. The thiosulfonate is toxic to the bacteria so that investigation at low concentrations was necessary. Even so, a considerable measure of protection was observed under the conditions of these experiments at pH 7.3 but not at pH 4.0 when the compound is more stable chemically. Of those bacteria which survived the inherent toxicity of the substance (55% of a control sample), three quarters survived an LD_{50} radiation dose. While this seems only a moderate measure of protection, it was much greater than that afforded by the other substances examined, all at pH 7.3 under similar conditions. The protection afforded by the thiosulfonate was therefore considered significant. The data obtained for cystamine indicated moderate tox-

icity and no protective ability while those for hypotaurine indicated very low toxicity and very slight protection. Thus the protective activity of the thiosulfonate cannot be ascribed to action of these substances produced by its spontaneous decomposition at pH 7.3. Even complete metabolic reduction of the thiosulfonate to cysteamine, an improbable occurrence particularly in air-saturated buffer, would not account for the level of protection observed. Cysteamine did protect S. marcescens, but to a markedly lesser extent than does the thiosulfonate. It is concluded, therefore, that the protective ability is an intrinsic property of this latter substance. The protection afforded by glycerol, included to give some basis for relating these studies to earlier work, was consistent with previous reports. Surprisingly, L-cysteine showed no protective activity under the conditions used. The thiosulfonate exhibited low toxicity and negligible protection of pH 4 where it is reasonably stable, possibly because of nonabsorption or metabolization under these conditions. The high radiation-sensitivity of this microörganism is commented on. It has an LD_{50} of 1490 rad, compared with about 3500 rad for E. coli B/r. (BBB)

33972 ON THE TREATMENT OF PERSONS POISONED AND ENDANGERED BY RADIATION. Mosebach, K.-O. (Universitat, Bonn). Med. Welt, 18: 1019-21(May 5, 1962). (In German)

Radiation syndrome is treated symptomatically. A number of sulfhydryl compounds, such as cysteine, cysteamine, and phenothiazine, have proven to be useful for this purpose. Four hypotheses have been advanced to explain their effects. These are that (1) these compounds reduce the partial pressure of 0 of the cells by autoxidation, (2) these compounds reduce the cellular oxidation products induced by irradiation, (3) because of their reactability, these compounds may assume the functions of the cell components destroyed by irradiation, or (4) these compounds react with the sulfhydryl groups of the radiosensitive cell components, forming mixed disulfides, and thus mask them against the irradiation effects. Generally, these sulfhydryl compounds are effective only if they are administered prior to the radiation insult. When radioisotopes have been incorporated into the organism the main purpose is to use methods and materials to prevent their absorption and increase their excretion. After oral ingestion, laxatives or materials that decrease solubility should be given to reduce absorption from the gastrointestinal tract. After inhalation or injection, blood clearance and excretion of radioisotopes can be accelerated by administration of zirconium or chelating agents. (BBB)

33973 CONCERNING A CASE OF DEEP INJURY CAUSED BY FOREIGN BODIES HEAVILY CONTAMINATED BY PLUTONIUM-239. DECONTAMINATION SURGERY UNDER SURVEILLANCE OF A NUCLEAR DETECTION DEVICE. Pilleron, J.-P.; Jamet, H.; Lafuma, J.; Manquene, J.; Gongora, R. (Foundation Curie, Paris). Mem. Acad. Chir., 90: 323-9(Apr. 8-15, 1964). (In French)

An unusual surgical problem is described concerning the treatment of a 19-yr-old male laboratory technician whose hands were injured in the chemical explosion of a column of an acrylic resin containing plutonium, which left about 50 μC of radioactivity in fragments of glove, glass, and resin in his hands. Radiation was so intense that it exceeded the count rate of detectors. Initial decontamination and removal of foreign bodies reduced the radioactivity to about 15 μC, thus permitting more accurate measurement of the radiation level. Blood and urine tests were made to detect possible internal contamination. Then, a decision was made to try to save the hands by removal of Pu-contaminated tissue. Radiography revealed the location of many lesion areas and particles, particularly in the left hand. General anesthetic and tracheal intubation were used. Foreign bodies were removed and measured for radioactivity; instruments were also monitored and replaced by fresh ones if contaminated. Postoperatively, complete decontamination of the right hand was obtained, and a reduction of the level in the left hand to 4 μC. X-ray detector cartography was undertaken to identify the precise areas still contaminated, and further surgery was performed. As a result, the level was lowered to 2 μC in the left palm. To control internal contamination as well as to aid elimination of Pu from the left hand, a final stage of treatment was begun: the use of chelating agents, such as DTPA. Problems involved in treatment of this case, which depended on the nature of ^{239}Pu, in the form here of plutonium nitrate, are discussed. Its effect was concentrated in one area, rather than diffuse. It emits α rays that cannot be detected outside the tissues themselves, but the weaker x rays, about 15 Mev, were useful for detection. In this case, Pu entered into all the tissues themselves, rather than adhering to the glass and resin debris. Three kinds of contamination danger had to be guarded against: (1) respiratory, from radioactive aerosols, which was avoided by ventilation at the scene of the accident; (2) skin level, which was restricted by prompt decontamination, so that the α particles penetrated only to about 35 μ of the skin's depth which totals about 70 μ thickness; and (3) deep penetration, which was a danger primarily in the abraded areas. As to treatment, the chelating agent DTPA could only be used secondarily, since its exact effects on the body and in combination with Pu are uncertain. Amputation is the usual treatment in such a case, but the patient's youth suggested more conservative yet somewhat experimental treatment. Radiation detectors used included an α counter; and an x-ray detector to check the particles removed. Extra protective coverings of polyvinyl film were necessary for operating room and hospital personnel, and were disposable. Possible late effects suggested by animal experiments include sarcoma in bone or the affected tissue, but this has not yet been observed in the patient. Internal contamination, measured by blood and urine tests, was markedly decreased. The case sets an important precedent in surgery for radiation injury, because amputation was not used. (BBB)

33974 PROTECTION AGAINST IONIZING RADIATIONS IN NUCLEAR INDUSTRIES. Deforge, A. Protect., Securite, Hyg. Trav., 44: No. 6, 5-30(June 1964). (In French)

The dangers of radioactive materials were studied. Various aspects of the safety program employed by industries controlled by the French Atomic Energy Commission reviewed include: establishment of maximum permissible radiation levels; elaboration and application of regulations; education of personnel; warning signs, and use of suitable equipment for the prevention of radiation and contamination Responsibility for technical safety measures falls on heads of departments with the assistance of safety engineers and other specialists. A number of safety organizations also give assistance to the French Atomic Energy Commission. Finally, a number of measures for the protection of personnel and equipment are reviewed. Descriptions of monitoring equipment are presented in an appendix. (auth)

33975 CORTISONE AND ACTH INFLUENCE ON RESISTANCE OF IRRADIATED ANIMALS TO BACTERIAL TOXINS. Kaulen, D. R. (Gamalei Inst. of Epidemiology and Microbiology, Moscow). Radiobiologiya, 5(3): 367-70 (1965). (In Russian)

Injections of small doses of cortisone increased the resistance of irradiated mice to Salmonella endotoxins and Perfringens toxin to the level of that in control mice. Single and multiple injections of cortisone to guinea pigs increased the severity of diphtheria intoxication but adrenocortical hormone had no effect. (tr-auth)

33976 INFLUENCE OF SULFUR-CONTAINING RADIOPROTECTORS ON BIOCHEMICAL CHANGES IN IRRADIATED ORGANISM. Dzharakyan, T. K.; Golubentsev, D. A.; Vladimirov, V. G. (Kirov Military Medical Academy, Leningrad). Radiobiologiya, 5: 415-22(1965). (In Russian)

Whole-body irradiation (gamma or x) of white rats to 600–750 R caused early and sharp disturbance in oxidative phosphorylation and exchange of ATP, DNA, and RNA in radiosensitive tissues. Cysteamine and its disulfide (75–100 mg/kg) decreased the effect but did not completely prevent it. The DNA content in spleen

lymphocytes, as determined by uv cytospectrophotometry, showed that the radioprotective effect of cystamine is exerted at the cell level. The prevention of irradiation damage in radiosensitive cells by cysteamine and cystamine also is probably the cause of the more rapid regeneration of blood-forming tissues. The results indicate a close relation among the observed biochemical processes. (tr-auth)

33977 ACTION OF CHEMICAL RADIOPROTECTORS DURING FRACTIONATED IRRADIATION. I. AET DISTRIBUTION IN THE ANIMAL ORGANISM AS A FUNCTION OF PROTECTOR DOSE, MEANS OF ADMINISTRATION, AND IRRADIATION CONDITIONS. Yarmonenko, S. P.; Ovakimov, V. G.; Palyga, G. F.; Fedoseev, V. M.; Tarasenko, A. G. (Inst. of Industrial Hygiene and Occupational Disease, Moscow and Moscow State Univ.). Radiobiologiya, 5: 423-7(1965). (In Russian)

Distribution of ^{35}S-AET in the organism did not depend on the dose, which, in contrast to the decreased effect of a single small amount and irradiation dose, contradicts the theory of antiradical and sulfide combination mechanisms. The mouse blood and liver AET contents were maximum 2.5 min after interabdominal injection and began to decrease after 30 min. In the brain ^{35}S accumulated gradually to a maximum at 30 min. When a lethal dose of AET was given at the moment of death of the animal, absolute content of the material in the brain was 2- to 4-fold lower than that accumulated with introduction of tolerable doses. Therefore, central action is important in acute AET toxicity. With fractional irradiation the AET distribution was no different, and therefore does not explain the lower protective action. (tr-auth)

33978 MECHANISM OF RADIOPROTECTIVE ACTION OF SUBCUTANEOUS TRANSPLANTATION OF HEMOPOIETIC TISSUES IN ACUTE RADIATION DAMAGES. Revis, V. A. (Kalinin Inst. of Medicine, USSR). Radiobiologiya, 5: 428-33(1965). (In Russian)

The radiation-protective effect of subcutaneous transplants is specific for hemopoietic tissues. Non-blood-fuming tissues (liver, muscle) did not show a protective effect on lethally x-irradiated rabbits. Transplants of preserved bone marrow also did not prevent death of irradiated animals. The mechanism of the radioprotective action of subcutaneous transplants of hemopoietic tissue apparently includes the combined effect of cellular and humoral factors in the transplant. (tr-auth)

33979 BIOPHYSICAL FACTORS CONDITIONING THE SURVIVAL OF MICE IRRADIATED AND RESTORED BY A GRAFT OF HEMATOPOIETIC CELLS. Doria, Gino (Institut de Radium, Paris). Rev. Franc. Etudes Clin. Biol., 6: 186-94(1961). (In French)

The physical factors determining survival during the 30 days after irradiation are: type, dose, and mode (internal or external) of irradiation. X rays and γ rays provoke lesions which can be restored by a graft of hematopoietic cells. Grafts are ineffective after neutron irradiation of one to eight Mev, but are frequently effective after 14 Mev. For a graft to take, the animal must have been exposed to at least the minimum lethal dose. This will destroy the hematopoietic tissue and inhibit the immunological defenses without causing irreparable damage. A supralethal dose causes irreparable lesions of the digestive tract and nervous system. Hematopoietic grafts will take after a single, total external irradiation. For internal irradiation, the efficiency of the graft is affected differently by different isotopes. Biological factors which influence survival are: age of the receipient, type of hematopoietic tissue utilized, physiological state of the injected cells (preservation, in vitro culture, immunization), number of hematopoietic cells injected, mode of injection, localization of the injected cells, and identification of the cell type responsible for restoration. After the 30th day following irradiation, the mortality rate increases, becoming stationary again at 120 days. This is the secondary syndrome, due to the reaction in vivo of the antigen and antibody. It remains uncertain whether the secondary syndrome is due to the regeneration of the host hematopoietic tissue which produces antibodies against the graft, or whether the cells of the graft form antibodies against the host. Some characteristics of the syndrome can be attributed to the delayed effects of irradiation or to the radiochimeras' weak resistance to infections. (BBB)

33980 INVESTIGATIONS OF THE ACTION OF SURFACE-ACTIVE MATERIALS ON THE RADIATION-PROTECTION ACTION OF SUBSTANCES CONTAINING SULFHYDRYL GROUPS ON ESCHERICHIA COLI. Magdon, Erwin; Schroeder, Elionor; Hirsch, Gertrud (Deutsche Akademie der Wissenschaften, Berlin). Strahlentherapie, 127: 282-6(June 1965). (In German)

Suspensions of Escherichia coli are protected against the effect of ionizing radiation when cysteine and cysteamine are present in the culture medium. No radioprotective effect was observed when the bacteria cells, after incubation with cysteamine, were irradiated in cysteamine-free culture media. Surface active substances did not increase the radioprotective effect of cysteine and cysteamine. (auth)

33981 ON THE ACTION OF THE LIPOPOLYSACCHARIDE-NUCLEIC ACID FRACTION OF E. COLI AFTER LETHAL WHOLE-BODY X IRRADIATION. Gabler, Eduard; Stoeckl, Wilhelm (Tierarztliche Hochschule, Vienna). Strahlentherapie, 127: 287-91(June 1965). (In German)

The lipopolysaccharide-nucleic acid fraction, isolated from E. coli, was found to be a radioprotective substance when given after a lethal total-body x irradiation. Survival rates up to 80% for albino rats and of up to 90% with guinea pigs were obtained when this fraction was administered subcutaneously in an aqueous solution about 15 min after exposure. The possible mechanism is discussed. (auth)

33982 INVESTIGATIONS OF BIOLOGICAL RADIATION PROTECTION. PART 63. THE INFLUENCE OF VARIOUS RESISTANCE INCREASING SUBSTANCES ON RADIATION-CONDITIONED CHANGES IN AMINO ACID METABOLISM OF MOUSE SPLEEN. Melching, Hans-Joachim; Streffer, Christian; Mavely, Devassy (Universitaet, Freiburg i. B.). Strahlentherapie, 127: 368-81(June 1965). (In German)

Radiation induced changes in the distribution of several amino acids in spleen tissue, was demonstrated in mice. The following results were observed after total body irradiation: an increase in cysteic acid and valine; a slight increase in α-alanine; and small changes in both cysteinsulfinic acid and taurine. 5-hydroxy tryptamine inhibited the increase of the amino acids during the first few hours after irradiation, but later there was no significant influence by the amine. Prophylactic administration of histamine as well as a combination of pyridoxal-5-phosphate +5′-AMP was found to decrease the radiation induced changes in the amino acid content between the 5th and 12th day post radiation. (auth)

33983 CURRENT VIEWS ON THE INDICATIONS FOR BONE MARROW TRANSFUSION. Steruska, M.; Hrubisko, M. (Karlova Universita, Bratislava). Vnitrni Lekar., 10: 259-65(Mar. 1964). (In Czech)

The use of bone marrow transplantation in the treatment of radiation disease and other conditions is reviewed. (87 references.) (BBB)

33984 COMBINED THERAPY OF ASSOCIATED PURULENT INFECTION AGAINST THE BACKGROUND OF PRECEDING GAMMA-RAY (RADIOCOBALT) INJURY. Churbanova, A. K. Zh. Mikrobiol, Epidemiol. i Immunobiol., No. 4, 78-82(Apr. 1963). (In Russian)

The treatment of Staphylococcus and Proteus infections in irradiated animals was studied in rabbits given 1500 R acute doses of ^{60}Co gamma rays 72 hours prior to the bacterial insult. Complex therapy consisting of treatment with antibiotics, a leukopoietic stimulant, and vitamin C reduced the duration of the infectious process and increased survival. In all animals the disease was accompanied by considerable depression of antibody formation up to the 5th to 10th days. Twenty days after infection, Proteus agglutinin titers were 1.5 to 1.87 time lower in rabbits receiving the complex therapy or antibiotics alone than in animals treated with aminopeptides, sodium nucleinate, and vitamin C and 1.3 to 1.6 times lower than in the controls. (H.G.D.)

33985 CHEMICAL PROTECTION AGAINST IONIZING RADIATION. Bacq, Zenon M. Publication Number 599, American Lecture Series. A Monograph in The Bannerstone Division of American Lectures in Living Chemistry. Springfield, Ill., Charles C Thomas, 1965. 339p. $14.00.

Chemical protection against ionizing radiation is considered in context of cellular biology. Historical and technical aspects are introduced. The various chemical protectors are discussed and information on pharmacological and biochemical effect is summarized. Metabolism and distribution of the sulfur-containing radioprotectors are considered. Detailed lists are given of multiple radiation effects (somatic, genetic, acute delayed) found to be sensitive or insensitive to chemoprotection. A comparison of chemoprotectant effectiveness was made for man, invertebrates, various vertebrates, plants, and tissue cultures. (H.G.D.)

Radiation Hazards and Protection

See also HEALTH AND SAFETY.

33986 (BNWL-SA-6) THE HANFORD CRITICALITY ACCIDENT: DOSIMETRY TECHNIQUES, INTERPRETATIONS AND PROBLEMS. Parker, Herbert M.; Newton, C. E. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [Jan. 11, 1965]. Contract AT(45-1)-1830. 20p. (CONF-650302-21). Dep.(mn), $1.00(cy), 1(mn) CFSTI.

From IAEA Symposium on Personnel Dosimetry for Accidental High-Level Exposure to External and Internal Radiation, Vienna.

A criticality accident occurred in a building where there were 22 employees on April 7, 1962 at the U. S. Atomic Energy Commission's Hanford Plant, located in the state of Washington. All of these employees were wearing film dosimeters. An official report of the dosimetry investigation, which essentially covers the period from eight hours to several weeks post-incident, has been published, and pertinent condensations of the findings are included. Hitherto unreported events are described and the lessons learned from this actual test of emergency procedures are discussed. The results of comprehensive evaluations conducted upon the three persons that received the highest doses are included. As a result of this accident, it was concluded that normal and alternate procedures should be designed around the primary purposes of emergency dosimetry; these being to segregate as rapidly and as knowledgeably as possible those personnel most likely to have suffered varying degrees of excessive radiation exposure, and provide physicians with timely and useful exposure data. As a result of the experience gained, it was concluded that the doses received may be estimated from quick-sort sodium-24 procedures, film badges, blood or blood serum sodium-24 activation analysis or whole body counting, and phosphorus-32 activation in hair. The other procedures to enhance the accuracy of the dosimetry to help in later scientific understanding of the observations made are relegated to more subordinate positions. It was also concluded that, even with a large and competent staff available to handle the situation, backup support in the nature of consultations with various experts is still desired. This may quite well be in the area of moral support, but nonetheless, is deemed necessary. It is especially useful to have a prepared list of readily available specialists in the area of dosimetry and medical treatment. (C.H.)

33987 THE PUBLIC HEALTH ROLE IN CONTROLLING RADIATION. Chadwick, Donald R. (U. S. Public Health Service, Washington, D. C.). Am. J. Public Health, 55: 731-7(May 1965).

Some current achievements and problems in the control of radiation exposure of the population are discussed. Major elements of radiological health programs are outlined. Four elements must be provided for in a comprehensive attack on the radiation exposure problem. First is the identification and measurement of all sources of radiation exposure of the population. Next is evaluation of exposures which must be based upon appropriate radiation protection standards. The development and application of methods of control is the third major element which must be provided in a radiation control program; more than any other element, this step requires the efforts of all of agencies and groups involved in the development and uses of radiation and radioactive materials. Finally, as in any public health endeavor, education and training of professionals as well as public information is an essential element. Education of radiation users is also a major factor in control and reduction of exposure. Much educational effort at present is being directed to physicians, dentists, nurses, and other medically related professions, and, through their various professional organizations, to scientists and teachers of science. Also discussed is the quality control program for the laboratories of the Division of Radiological Health of the Public Health Service, consisting of individual programs at each of our four major laboratories plus a Divisional Control Service serving all the laboratories. Several examples are cited of achievements in programs of radioprotection, namely, in reducing exposure from dental x-ray machines and in pointing out leakage of radiation from Ra storage devices. It was concluded that good progress is being made by health agencies in meeting their responsibilities for protection of the public against the hazards of undue radiation exposure. (TCO)

33988 THE NUCLEAR INDUSTRY BEFORE AMERICAN LEGISLATION. Zaldivar, Enrique (Universidad, Buenos Aires). Ciencia Interam., 4: 3-10(Jan.-Feb. 1963). (In Spanish)

The development of radioprotective legislation for industry is traced. (BBB)

33989 CARE OF THE PATIENT EXPOSED TO RADIATION. Love, Robert A. (Brookhaven National Lab., Upton, N. Y.). J. Pract. Nursing, 14: 22-3(Oct. 1964).

The major syndromes (hematopoietic, gastrointestinal, central nervous system) resulting from heavy radiation exposure are described, as well as their treatment, with emphasis on nursing care of such casualties. The patient should be hospitalized and isolated immediately. It is imperative that a heavily irradiated patient be placed in isolation, not because he is radioactive (he will not be if he were exposed to an external β-, γ-, or x-ray source) but to protect him from infection. He may have impairment of his immune mechanism, and his white blood cells may fall to a low level due to their irradiation. It is best, if possible, to have a separate nursing team to care for these cases so that the possibility of transferring infection to the patient will be minimal. A history, physical examination, blood count, and other special studies should be done. If the patient has been exposed to neutrons, a whole-body count, and urine, blood, and tissue bioassays may be made to detect the presence of radioactive sodium or phosphorus produced by the neutrons. This will be helpful in establishing the dose of radiation the patient received. The person should be kept isolated and at bed rest. The fluid and electrolytes must be watched closely. Antibiotics should be used only if indicated and should not be given prophylactically. Fresh whole blood and platelet transfusions are not needed initially, but they may be necessary later if the blood count falls. Only in extreme cases is bone marrow transfusion considered. Nausea and vomiting can be used as a rough guide to the size of the dose of radiation received. With a large dose, the patient will have intractable nausea and vomiting and prostration. With an intermediate dose, the patient will have nausea and vomiting for a day or two. With a smaller dose, nausea and vomiting will be mild and will last for only a few hours. If nausea and vomiting are absent, the dose was relatively low. The chance of serious acute injury from contamination is not so great as irradiation from an external source. At Brookhaven National Lab where there is a potential danger of contamination with radioactive material, a special personnel decontamination unit is available, and is described. Treatment following the entrance of a radioactive isotope into the general circulation is outlined. No one treatment can be applied, and each case must be evaluated and treated individually. It may be possible to influence the amount re-

tained in the critical organ by administering a stable isotope of the same material. Thus stable iodine given soon after radioiodine has entered the body may decrease the amount of radioiodine taken up by the thyroid. Chelating agents and other procedures may be effective in some cases in increasing elimination and decreasing the body's burden of the material that has entered. Of all the factors in the case and treatment of severe radiation casualties, among the most important is good nursing care. (BBB)

33990 DETECTION AND MEASUREMENT OF RADIOACTIVE MATERIALS IN HUMAN BODIES. Eich, Hubert Wolfgang (Arndt-Apotheke, Saarbruecken, Ger.). Mitt. Deut. Pharm. Ges., 33: 161-5(Sept. 1963). (In German)

Radioisotopes of various kinds may be incorporated by humans in various ways and thus become a greater hazard than the environmental irradiation normally received. The detection and reduction of danger from internally deposited radioisotopes is possible with the whole-body counter. This counter can also be used to detect radioisotopes deposited in amounts too small to produce irradiation damage. The author reviews briefly the physical characteristics and capabilities of whole-body counters at Los Alamos and at Landstuhl-Pfalz, in Germany. Their use to detect internally deposited radioisotopes is outlined, and the relation of these measurements to values established for maximal permissible amounts is discussed. The usefulness of the whole-body counter for supervision of personnel employed in occupations that used radioisotopes is outlined and discussed briefly. (BBB)

33991 CHANGING ASPECTS OF FOOD AND DRUG CONTROL. Coles, L. E. (Inst. Preventive Medicine, Cardiff, Wales, U. K.). Roy Soc. Health J., 84: 101-4 (Mar.-Apr. 1964).

Some of the problems of local laboratories in the U.K., manned by a county or public analyst, in ensuring safety of food products for human consumption are considered, including the monitoring of fallout levels in food. When the importance of milk and milk products is assessed in the general contribution to the human diet, it is necessary for the public analyst to be aware of any type of contamination of milk products, whatever it may be. The radioactive contamination is particularly important. A few of the larger local authorities have authorized their public analysts to acquire the necessary equipment to test for radioisotopes. This work is highly specialized and has been undertaken by the Agricultural Research Council, which systematically monitors ^{89}Sr, ^{90}Sr, ^{131}I, ^{137}Cs, and ^{140}Ba in milk and other foodstuffs at hundreds of sampling points throughout the country. The latest report on radioactivity in human diet shows that between January and March 1963 the ratio of ^{90}Sr to Ca in milk ranged from about 80 to 100% of the average for 1962, which in any localized area did not reach 20% of the appropriate working level. This type of examination is more properly carried out at a national level, since so many factors other than reporting activities must be taken into consideration. For example, knowledge of the type of pasture, soil condition, and rainfall are important factors which affect the degree of contamination of foodstuffs with fallout. The role of the public analyst in this field should be that of general scientific adviser to the local authority; he should be able to assess the general situation from ministry reports, and be so well acquainted with radiochemistry that any problems, arising within his own area, may be answered to the satisfaction of his council. There is a need for the larger labs to have facilities available for the occasional use of simple monitoring apparatus. The reason for this is that, firstly, routine examination of the water supply (for total activity) would give immediate indication of any sudden change in the general level of above-background radiation, without having to wait until government reports are published. Secondly, since radioisotopes are now commonly used in medicine, agriculture, engineering, scientific research, and food processing, the varied nature of the public analyst's work makes it probable that at some time or other he may be asked to give advice on problems involving radiochemistry. Thirdly, the 1963 British Pharmacopoeia includes ^{51}Cr, ^{32}P, and ^{131}I in certain monographs, and the Food and Drugs Act is at present the only means under which these standards can be checked. (BBB)

33992 MANUEL DE PROTECTION CONTRE LES RADIATIONS DANS L'INDUSTRIE. (Manual of Protection Against Radiations in Industry. Parts III, IV, and V). Geneva, Bureau International du Travail, 1964. 222p. 5 sf(Pt. III); 4 sf(Pt. IV); 5 sf(Pt. V).

Radiotherapy and Radiodiagnosis

Refer also to abstract 33766.

33993 BREAK THROUGH PHENOMENON DURING TREATMENT OF RADIATION DERMATITIS WITH FLUOCINOLONE ACETONIDE. Bjoernberg, A.; Hellgren, L.; Olsson, S. Acta Allergol., 19: 515-18(1964).

During a study of the effect of fluocinolone acetonide ointment on radiation dermatitis a severe break through phenomenon of the radiation skin reaction was observed in four out of 23 patients who were treated for malignant tumors with x radiation. (Excerpta Med.)

33994 INTRACAVITARY IRRADIATION IN TREATMENT OF CARCINOMA OF CERVIX WITH PARAVAGINAL EXTENSION. Kottmeier, H.-L.; Walstam, R. (Karolinska Sjukhuset, Stockholm). Acta Radiol. Therapy, Phys., Biol. 3: 161-8(June 1965).

Various methods for improving the dose distribution to the paravaginal tissue in the irradiation of cervical carcinoma are discussed, and a comparison is made. An intravaginal electron beam irradiation technique was tried during a 5-year period in 31 selected patients with cervical carcinoma having paravaginal extension. Results were encouraging. (H.G.D.)

33995 ERYTHEMA DIFFERENCES BETWEEN THE CRANIAL AND CAUDAL PARASTERNAL REGIONS AT 12 Mev ELECTRON IRRADIATION. Notter, Gustaf; Tsioulias, Tassos; Åsard, Per-Erik (Karolinska Sjukhuset, Stockholm). Acta Radiol. Therapy, Phys., Biol., 3: 177-82 (June 1965).

Results are reported of photometric evaluation of dermal erythema in 16 patients with breast cancer by measurements before, during, and after irradiation of the parasternal region with 12 Mev electrons, infractionated doses of 10 × 400 R_s over 22 days. Erythema was more marked in the region cranial to the second intercostal space, corresponding to the innervation field of the nerves from the cervical spine, with C4 as the lower limit. The differences in the radiation erythema between the regions cranial and caudal to this thoraco-cervical border were significant. (H.G.D.)

33996 EXIT DOSE MEASUREMENTS IN COBALT 60 TELETHERAPY. Sundbom, Lennart (Karolinska Sjukhuset, Stockholm). Acta Radiol. Therapy, Phys., Biol., 3: 193-209(June 1965).

A method is presented for calculating three dimensional doses in patients by using exit dose measurements. Calculation of dose distribution is discussed for obliquely incident beams and for beams passing through air-filled lungs. The use of exit dose measurements for distribution calculations was tested by irradiating an anatomical thorax phantom. Deviation between measured and calculated dose was within ±3% in the case of obliquely incident beams and ±10% in the case of beam passage through air-filled lungs. (H.G.D.)

33997 METHOD OF DOSE PLANNING ON APPLICATION OF SHIELDING FILTERS IN COBALT 60 TELETHERAPY. Sundbom, Lennart (Karolinska Sjukhuset, Stockholm). Acta Radiol. Therapy, Phys., Biol., 3: 210-15 (June 1965).

It is sometimes desirable in radiotherapy to protect tissue enclosed within a volume that is to be given a high dose. The protection can be achieved by inserting absorbers

(shielding filters) in suitable positions in the beam. The influence of these filters on the dose distribution may be described with subtractive isodose charts that will facilitate dose planning with shielding filters arbitrarily placed in different beams. The accuracy obtained is satisfactory. (auth)

33998 THE DIRECT DIAGNOSIS OF MYOCARDIAL INFARCTION BY PHOTOSCANNING AFTER ADMINISTRATION OF CESIUM-131. Carr, E. A. Jr.; Gleason, G.; Shaw, J.; Krontz, B. (Univ. of Michigan, Ann Arbor). Am. Heart J., 68: 627-36(1964).

It is possible to visualize the left ventricular myocardium of the intact, living patient, without discomfort or danger to the patient, by photoscanning after the administration of cesium-131. The normal left ventricular myocardium appears as a full, even density, with a smooth contour. Myocardial infarcts appear as cold areas of deceased uptake. In 6 patients with unequivocal fresh myocardial infarcts, the scans were positive in 5 and doubtful in 1. In 2 patients who probably had suffered recent myocardial infarctions, the scan was positive in 1 and negative in 1. In 2 patients who had heart disease but who had probably not had recent myocardial infarctions, the scan was negative in 1 and doubtful in 1. The scan was negative in each of 3 patients with normal hearts. (Excerpta Med.)

33999 CARDIAC IRRADIATION IN CHILDHOOD LEUKEMIA. Haddy, Theresa B. (Univ. of Oklahoma, Oklahoma City). Am. J. Diseases Children, 108: 559-65(Nov. 1964).

A child with acute leukemia whose intractable cardiac failure was controlled by cardiac irradiation is described. Electrocardiograms before and after irradiation are illustrated. Infiltration of the heart occurs in one third of patients with leukemia, but cardiac symptoms appear only occasionally, usually secondary to anemia. In a few cases of infiltration of the myocardium or pericardium with symptoms of myocarditis, heart block, or pericarditis anterior mediastinal irradiation has been used. In the present case, in spite of steroids, antibiotics, blood transfusions, oxygen, diuretics, digoxin, and several nonproductive thoracenteses, signs and symptoms of cardiac failure persisted, and radiation therapy was therefore begun. A total of 2025 R in air was delivered during a month to the anterior mediastinum. Evidences of cardiac failure gradually cleared during radiation therapy. The heart size decreased and the electrocardiogram returned to normal. Mercaptopurine failed to induce a hematological remission, and in spite of the cardiopulmonary improvement, the general condition deteriorated. At autopsy, no cellular infiltrate was present in the heart although epicardial thickening was observed. The pericardium appeared normal. The diagnosis of leukemic myocarditis was based on the picture of heart failure appearing in the absence of the usual cardiac lesions, hepatic damage, or renal insufficiency. The preirradiation electrocardiographic changes were compatible with myocarditis. The diagnosis was supported by the patient's clinical improvement after irradiation and previous failure to respond to adequate treatment with digoxin and other conventional supportive measures. It was of interest that autopsy did not reveal leukemic cells in the myocardium following localized radiation therapy. About half of patients with leukemic meningitis who improve after radiation do not show intracerebral or meningeal infiltrates at autopsy. (BBB)

34000 COMBINED INTRA-ARTERIAL CHEMOTHERAPY AND RADIATION TREATMENT FOR ADVANCED CERVICAL CARCINOMA: THE McCALL TECHNIQUE AND RESULTS. Hulka, J. F.; Bisel, H. F. (Univ. of Pittsburgh). Am. J. Obstet. Gynecol., 91: 486-90(Feb. 15, 1965).

A new technique, combining perfusion with chemotherapeutic agents and irradiation with x rays, ^{60}Co γ rays, or 6-Mev electrons, is described and results are reported for 13 patients. Perfusion is performed by a technique of hypogastric artery catherization through a retroperitoneal approach, followed by prolonged intermittent chemotherapy. Very high total doses of chemotherapeutic agents (up to 15.25 g of 5-fluorouracil) perfusing the pelvis were achieved. All four patients undergoing chemotherapy prior to irradiation for Stages III and IV of cervical carcinoma have survived and are free of disease. Those treated after unsuccessful radiation therapy alone succumbed within a year. Toxic reactions with these high doses were minimal, and limited to skin erythema. External irradiation or Ra implantation was begun 2 to 4 weeks after chemotherapy had been completed. Of the four successfully treated patients who received external radiation with a 250-kv x-ray machine to a total target dose of 3456 R, followed in two months by ^{60}Co treatment with the Ernst applicator in two applications to a total dose of 6356 R to point A. The second patient underwent two insertions of ^{60}Co in an applicator a month apart with a total dose to point A of 5484 R, followed by a course of external radiation with the 250-kv x-ray machine to a total target dose of 2614 R. The third patient received 4628 R to point A with ^{60}Co in an Ernst applicator, followed in 4 months by external radiation with the 250-kv x-ray machine to a total target dose of 3971 rad. The fourth patient underwent a course of external radiation with the 6-Mev linear accelerator to a total target dose of 4598 rad, followed by a total of 4000 rad to point A with a ^{60}Co applicator. The survival of all four of these patients who underwent chemotherapy prior to radiation suggests that there may be a synergistic action between these two therapeutic modalities when given in this sequence. (BBB)

34001 SEQUENTIAL RADIATION AND OPERATION IN CARCINOMA OF THE UTERINE CERVIX. Decker, David G.; Aaro, Leonard A.; Hunt, Arthur B.; Johnson, Carl E.; Smith, Reginald A. (Mayo Clinic, Rochester, Minn.). Am. J. Obstet. Gynecol., 92: 35-42(May 1, 1965).

Technique, results, and complications of combined radiotherapy and surgery in 115 patients are described. Radiation therapy consisted of external x-ray or ^{60}Co teletherapy administered concurrently with intracavitary Ra therapy given by the intensive divided dose technique. Radium applications were given twice weekly over a 4-week period. Point A received at least 7000 R and Point B at least 2000 R. X-ray (250-kv) therapy was administered to two anterior and two posterior pelvic ports with midline protection between adjacent zones. Daily treatments of 200 R (air) were delivered for a total dose of 2000 to 2400 R per port. When teletherapy with ^{60}Co was employed, a midplane pelvic dose of 3500 to 3700 R was delivered. After the radiation treatment was completed, the patient returned in six weeks to three months for surgery. Of the 115 patients, 88 had no evidence at surgery of residual malignant disease in the cervix or involvement of lymph nodes. Of these 88 patients without evidence of malignant disease at operation, 90.9% survived five years. There were three patients with radioresistant lesions of the 115 patients. Complications of therapy are discussed. One death was an operative mortality, but no deaths were directly related to the radiation therapy. In all 33 of the 115 patients had major complications after irradiation plus operation. It was concluded that this high rate of major complications from treatment should discourage widespread use of such combined therapy. (TCO)

34002 PRIMARY SQUAMOUS CELL CARCINOMA OF THE THYROID GLAND: REPORT OF A CASE AND REVIEW OF THE LITERATURE. Goldman, Ronald L. (Univ. of California, San Francisco). Am. Surgeon, 30: 247-52 (Apr. 1964).

The incidence, pathogenesis, and treatment of this rare type of cancer are reviewed and one new case is described in detail. The radioresistance of this cancer is emphasized. Radiotherapy of squamous cell carcinoma of the thyroid is invariably unsuccessful. (BBB)

34003 TOTAL THYROIDECTOMY AND I^{131} IN THYROID CANCER. Rappaport, Irving; Shiffman, Melvin A.; Bodfish, Ralph (Veterans Administration Hospital, Long Beach, Calif.). Am. Surgeon, 30: 511-14(Aug. 1964).

Dose factors in the use of ^{131}I to diagnose and treat thyroid carcinoma are considered. Each patient with a mass in the thyroid is given ten μC of ^{131}I to determine the uptake of the gland, and a scintigram is performed three to five days later. The dose of ^{131}I for the scintigram depends upon

the uptake of the thyroid and is calculated to place 20 to 30μC of ^{131}I into the gland. Patients with cold nodules (where the concentration of radioiodine is less than the remainder of the thyroid) are further investigated by surgical means. If thyroid carcinoma is found, the scintigram is repeated and a total-body scan performed two weeks after surgery. Between 500 to 1000 μC of ^{131}I is used for the scan, the amount depending upon how much thyroid tissue has been removed. A scintigram is performed over any hot spot noted on the total-body scan. Residual normal thyroid tissue is ablated with 50 mC of ^{131}I. A remnant of thyroid tissue is found in most cases following total thyroidectomy. If hemithyroidectomy has been performed, 25% of the patients will require a repeat dose of radioiodine in three months to eradicate the remaining portion of the gland. When residual tissue is thought to be carcinoma, 100 mC of ^{131}I is given. The patient is then started on desiccated thyroid, increasing the dose to as large as tolerated. After three months, the patient is given ten units of thyroid stimulating hormone (TSH) daily for five to seven days. Following this, 500 to 1000 mC of ^{131}I is given and a total-body scan with a scintigram is done. Residual tumor is treated with an ablative dose of ^{131}I. Any tumor capable of taking up ^{131}I may be treated this way, but carcinomas of the follicular type are more likely to concentrate iodine. The metastatic deposit may not be pathologically the same as the primary tumor and, therefore, may concentrate ^{131}I when the primary is not of the histologic type ordinarily found likely to take up ^{131}I. (BBB)

34004 RADIOACTIVE SUBSTANCES IN THE TREATMENT OF SKIN DISEASES. Schirren, C. G. (Dermatologiche Klinik, Universitaet, Munich). Arch. Klin. Exptl. Dermatol., 219: 474-94(June 25, 1964). (In German)

In treatment of skin diseases α-particle emitters no longer have any importance. There is no sound reason why ThX should be used in dermatological clinics. Its disadvantages outweigh by far its possible advantages. In dermatoradiotherapy β emitters have some value, depending on the symptoms present. However, their value may be somewhat overestimated. Artificially produced β emitters are used most effectively in dermatological conditions where the skin disorder treated extends at most from 1 to 2 mm below the skin surface. One disadvantage of the use of β emitters is that they give rise to bremsstrahlung. Because of inattention or negligence of proper protective measures these may irradiate technical or medical personnel more than has been assumed heretofore. Usually, β emitters are best used in conjunction with x irradiation treatment, but most frequently they are used at times when they are not really the best forms of treatment. In most instances treatment can be better given with soft x irradiation. Whether they occur naturally or are artificially produced, γ emitters do not have much importance in dermatological practice. Probably, the greatest possibilities for irradiation treatment of skin diseases would be provided by electrons accelerated up to energies of 6 Mev. References cited, 42. (BBB)

34005 USE OF RADIOACTIVE ISOTOPES IN DERMATOLOGY. Kaercher, K. H. (Universitaet, Heidelberg). Arch. Klin. Exptl. Dermatol., 219: 494-7(June 25, 1964). (In German)

For flat cavernomas, naevi, or basiliomas, as well as lenticular melanomas and mammary metastases, ^{90}Sr-^{90}Y are the most often used β emitters. Bremsstrahlung components of these radioisotopes amount to only 1%, and the exponential decay of the irradiation is more favorable than soft x irradiation. As used, an applicator of this type contains 50 mC with a Ni filter 0.1-mm thick, and gives a dose rate of 4200 R/min. For treatment of flat cavernomas or naevi four doses of 1500 R each are used. Higher dosages are necessary for melanomas and basiliomas. Compression is necessary to ensure a uniform irradiation, and several fields may be irradiated in sequence. Another method used is the application of a plaster form in which ^{90}Y particles are embedded. These give a dose rate of 100 to 150 R/hr, and are used for one-time irradiations. However, this treatment may produce an unwanted irradiation reaction, with exudation and secondary infections. Compared to this the ^{90}Sr applicator requires more than one treatment exposure, but the side-effects are much less and better results are obtained. Contact irradiation of extensive skin malignancies can be treated by plastic moulages that contain ^{60}Co. (BBB)

34006 BRAIN SCANNING WITH CHLORMERODRIN ^{197}Hg AND CHLORMERODRIN ^{203}Hg. Rhoton, Albert L. Jr.; Carlsson, Anna-Marie; Ter-Pogossian, Michel M. (Washington Univ., St. Louis). Arch. Neurol., 10: 369-75(Apr. 1964).

Development of this technique, its advantages over other methods, radioisotope doses used and radiation exposure of patients, and clinical results in 67 patients are reported. The isotope initially used was ^{203}Hg tagged to chlormerodrin, found to be significantly better than albumin ^{131}I. The ^{203}Hg decays with a half life of 45.8 days with the emission of a low energy β particle to an excited state of ^{203}Tl, which in turn emits a single 0.28 Mev γ ray. Because of chlormerodrin's rapid renal excretion, whole-body biological half life is only eight hr. Administration of 10 μC/kg of chlormerodrin ^{203}Hg to a patient results in a whole-body exposure of 290 mrad as compared to 700 mrad delivered by injection of 5 μC/kg of ^{131}I-labeled serum albumin. The main disadvantage of chlormerodrin ^{203}Hg is the retention of 10% of the dose in the kidneys with a biological half life of 28 days and delivery of 37 rad. Administration of meralluride (Mercuhydrin) on the day prior to the scan blocks the renal sites of binding and decreases the renal dose threefold. Using ^{197}Hg-tagged chlormerodrin for brain scanning, because of the shorter physical half life (65 hr) of ^{197}Hg and the absence of β-ray emission, the kidney dose is reduced to 3.06 rad, or $^1/_{12}$ of that with ^{203}Hg. The dose given is 700 μC of either isotope, intravenously three to five hr prior to the scan. In patients with known metastatic disease, doses as high as 1000 μC have been used. The main disadvantage of scanning was the demonstration of non-neoplastic lesions. However, the 84% success in tumor localization obtained illustrates the usefulness of the method, and this increased to better than 90% if only the lateral neoplasms within the cerebral hemispheres are included. This accuracy compares favorably with the results for other neuroradiologic techniques including air studies and angiography. The favorable results of scanning are especially significant when the low risk and application of the method to outpatient use are considered. The scan exhibits also the possible added advantage of showing the uptake within the tumor, and thus localization does not depend on displacement of vessels or ventricular system, both of which may be at some distance from the tumor. It is emphasized that chlormerodrin ^{197}Hg reduces the objectionable high renal dosage from ^{203}Hg and allows the examination to be used as a repeatable procedure, useful in following the postoperative and postirradiation course of patients. (BBB)

34007 SCINTIGRAPHY OF THE CERVICAL LYMPH SYSTEM. Schwab, W.; Scheer, K. E.; zum Winkel, K. (Universitaet, Heidelberg). Arch. Ohren. Nasen, Kehlkopfheilk., 183: 382-7(1964). (In German)

Colloidal ^{198}Au, with a particle size range from 5 to 15, is transported by way of the lymphatic system when injected subcutaneously into the retroauricular region or into the supratonsillar mucosa. The dose used ranges from 50 to 100 μC. The total volume used is from 0.5 to 0.7 ml. Diffusion from the injection site can be accelerated by administration of kinetin 75E. However, in normal persons from 30 to 50% of the injected radiocolloid remains at the injection site. There is some diffusion into the supraclavicular lymphatic bed. Scanning is performed from 6 to 24 hr after injection. After the ^{198}Au is injected unilaterally it is possible to obtain scintigraphic measurements bilaterally, indicating that there is some contralateral lymphatic flow. Most of the radioactivity can be detected in the lymphatic bed of the neck, but it is also found in the nuchal area. Deposition of the radioisotope in the lymphatic drainage areas where it was detected scintigraphically was confirmed in cases where the nodes in the neck were removed surgically. According to these and similar results the injection of

cytostatic agents into the lymphatic system to prevent metastases is relatively ineffective, because the cytostatic agent is not readily transported to the tumor site. (BBB)

34008 RADIATION AND DRUG INDUCED HYALINIZATION OF THE STOMACH. Smith, J. Chandler; Bolande, Robert P. (Western Reserve Univ., Cleveland). Arch. Pathol., 79: 310-16(Mar. 1965).

Extensive hyalinization of the gastric wall was observed in five patients in whom the stomach was inadvertently irradiated for the treatment of extragastric malignant disease. Hyalinization occurring at multiple focal sites was also seen in the stomach of a patient with leukemia who was treated with radiomimetic drugs only. Although reports of the effects of radiomimetic drugs on the stomach are few, x radiation is known to cause both functional and morphologic changes. Not found among these reports, however, is an account of focal or diffuse hyalinization of the gastric wall. The present report describes this lesion and speculations on its pathogenesis are offered. Although the lesion appears to be uncommon, and in these six instances was incidental to the treatment of extragastric malignant disease, it is a remarkable structural alteration and deserves the notice of pathologists. Furthermore, the use of x radiation for the treatment of benign gastric lesions suggests that other reports of mural hyalinization may be forthcoming. The gross features of the radioinduced lesion are a stomach wall that is rigid, a rugal pattern that is effaced, and a mucosal surface that is granular, pale gray, and somewhat translucent. When caused by irradiation, the lesion tends to be large and presumably delineates the portion exposed. In the cases described, that portion was regularly large and in the fundus; the antrum was not involved. When drug induced, the lesion, as observed in a single case, consisted of multiple small oval foci. The increased thickness of the wall was less conspicuous than the rigidity of the wall which was pronounced. In three cases the resemblance of the stomach to parchment was noted, and in manual bending of the wall a sudden break was accompanied by an audible popping sound. Pallor of the surface, often approaching whiteness, was due to sparse remnants of mucosa overlying a thick hyaline layer that is nearly devoid of small vessels. The cut surface presented a gray, firm, structureless layer of uniformly increased thickness that extended through the wall and deeply into the external muscularis. The serosa was not grossly altered. Microscopically the mucosa was effaced, and the surface covered by a thin layer of granular basophilic debris in which occasional gland formation was seen. The subjacent hyaline layer was thick, uniform, and devoid of capillaries. Moderately large arteries and veins persisted and were patent. The vessel walls displayed focal and occasionally diffuse mural hyalinization. A striking histologic feature was the absence of a leukocytic infiltration. Slight fibrosis was present in the serosa although hyalinization was not seen. The juncture between hyaline and intact external muscle bundles was sharp. Close examination of marginal sites revealed the ghost outlines of muscle filaments in which pale and poorly staining shadow nuclei could be made out. At these sites a merging of muscle and hyaline was apparent and the intervening margin obscure. Special stains failed to reveal the composition of the hyaline material, but most of the hyaline material appeared to be a nonfibrillar condensate of protein. The mucosal lesion was regarded as an effacement rather than an ulcer. That the process evolves slowly is suggested by the indolent appearance of the histologic change. The shortest time interval from treatment to autopsy examination was five months; the longest, four years. The x-radiation dose given in the five cases was 1500, 3606, 3918, 4498, and 9563 rad. Relatively few descriptions of the morphologic effects of radiation on the stomach have been reported; these are reviewed. (BBB)

34009 LOCALIZATION OF LEFT-TO-RIGHT SHUNTS BY RADIOACTIVE KRYPTON. Weitzman, David; McAlister, Joan; Houlder, Anthony. (St. Bartholomew's Hospital, London). Brit. Heart J., 26: 577-83(Sept. 1964).

Advantages of ^{85}Kr over the authors' previous method using ^{32}P as a tracer in congenital cardiac lesions are examined, and a procedure using ^{85}Kr is described. The ^{32}P method has a physical half-life of 14.3 days, and a fairly long biological half-life: hence the test cannot easily be repeated in the course of a single catheterization. Two separate catheters have to be inserted for injection and sampling. A false positive test can result from pulmonary valve incompetence. Krypton-85 has several advantages over other possible radioactive gases. First, it is inert, and so has a very short biological half-life, being completely cleared from the body in the exhaled air within a few min. A fairly large dose can therefore be given without significant radiation risk; in addition, the investigation can be repeated after a very short time interval, thus eliminating the necessity for simultaneous sampling. Secondly, it has a long physical half-life, so that it is easy to maintain a constant supply. Thirdly, it is almost a pure β emitter, which is an advantage in exact time measurements. Problems in handling ^{85}Kr are discussed, and in view of the >Curie amounts being stored in a cylinder, a special all-metal system was designed and constructed to dispense samples for clinical tests. A glass ampoule containing 500 mC of ^{85}Kr was connected by a metal-to-glass seal and the gas transferred to the storage chamber, the pressure being brought up to atmospheric with inactive krypton. The krypton is stored in this chamber and 10-mC doses are dispensed as required into a sampling tube which may be connected by a standard vacuum union. For max sensitivity a scintillation flow-counter was used for the detection of ^{85}Kr in blood. The radiation emitted by ^{85}Kr is 99.3% β radiation of max energy 0.67 Mev, and only 0.7% γ radiation of energy 0.54 Mev. The lower energy β radiation is easily absorbed, the intensity being reduced to one-half by 0.004 in. Al. In the scintillation flow-counter, the blood actually flows through, i.e. is in direct contact with, a coil of plastic phosphor, and there is no loss in efficiency due to absorption, apart from self-absorption. A comparison of the sensitivity to Kr, of the scintillation counter, and the end-window Geiger counter method used previously for ^{32}P is shown. The scintillation counter is about 10 times as efficient as the end-window counter. In the described procedure the subject inhales a single breath of ^{85}Kr, while blood, withdrawn by catheter from different right heart chambers in turn, is continuously monitored by the scintillation flow-counter. By this technique, radioactivity can be detected downstream of a left-to-right shunt ~10 to 12 sec before its arrival proximal to the defect via the normal circulatory pathway. This assessment of time interval leads to more accurate localization than a comparison of saturations. The technique was safe and proved valuable in different problems. However, it requires elaborate apparatus and careful precautions to avoid leakage of radioactive gas. These are justifiable when investigating a patient in whom routine methods suggest a complicated lesion. (BBB)

34010 PLASTIC SURGERY IN RELATION TO RADIOTHERAPY FOR CANCER OF THE MOUTH. Joss, George (Mount Vernon Centre for Plastic Surgery, Northwood, Eng.). Brit. J. Plast. Surg., 17: 88-94(Jan. 1964).

Plastic surgical techniques used to repair lesions resulting from irradiation of cancers in the mouth region are described with reference to 24 cases which required such surgery. None of the patients who had received previous irradiation healed primarily; that is, all patients developed a breakdown of the intra-oral suture line, ten of them with fistula formation. In seven patients in whom a simultaneous block dissection was carried out when they had received radiotherapy previously, fistula formation occurred. In not one of nine patients who had similar gland dissection did a fistula form when there was no history of previous x-ray treatment. In four patients an attempt was made to repair the floor of the mouth by introducing local flap tissue. However, in each case the flap had been included in the radiotherapy field and breakdown of the suture line occurred just the same. In one instance the patient had previously received supravoltage irradiation

through an area which was subsequently used as a flap, and this too broke down. In two patients both lingual arteries were ligated in order to minimize hemorrhage, but in both the anterior two-thirds of the tongue necrosed and subsequently separated. It is concluded that, in previously irradiated cases, when the local excision is to be extensive, tissue should be imported in the form of flaps from areas which have not been included in the field of irradiation. (BBB)

34011 THE RESULTS OF USING RADIOACTIVE GOLD GRAINS IN THE TREATMENT OF BLADDER GROWTHS. Munro, A. I. (St. Bartholomew's Hospital, London). Brit. J. Urol., 36: 541-8(Dec. 1964).

The technique, doses used, results, and complications of implantation of radiogold for bladder cancer in 151 patients are presented. The grains, each containing 4.5 mC of ^{198}Au are inserted by suprapubic cystotomy with primary bladder closure, or under cystoscopic control by suprapubic puncture, vaginal puncture, or the transurethral route. Using diathermy the tumor is resected down to its base, and the implant performed aiming at a tumor dose of 700 R. The five-yr survival rate for mucosal stage carcinoma was 70.4% and for muscular stage carcinoma 38.9%. These results are comparable with those obtained from other methods. Although no patient with a perivesical stage tumor has survived five years, in most cases palliation was achieved. At the same time the proctitis and skin ulceration which may result from external radiotherapy were avoided, but there was a high operative mortality in this group and it may be that better results would be obtained with supervoltage therapy. External irradiation has largely replaced interstitial and intracavity techniques in the treatment of bladder tumors. Intracavity techniques have proved unsatisfactory and have therefore been abandoned in most centers; however, interstitial irradiation is still widely used for patients with mucosal and muscular stage tumors. Further, from the present evidence, interstitial irradiation gives better five-yr survival rates than external irradiation in the treatment of mucosal and muscular stage tumors. The advantages of ^{198}Au, in the form of grains inserted by a repeater gun, are: ease and speed of implantation; uniform distribution; implantation under cystoscopic control by suprapubic or vaginal puncture or by the transurethral route; and economical reactivation when not used. None of the disadvantages of ^{182}Ta were found. (TCO)

34012 EFFECT OF THYROXINE ON EXOPHTHALMOS IN THYROTOXICOSIS. Koutras, D. A. (Athens Univ.); Alexander, W. D.; Buchanan, W. W.; Harden, R. McG.; Hunter, R. D. Brit. Med. J., 1: 493-5(Feb. 20, 1965).

The use of thyroxine to protect against the increase of exophthalmos in patients treated with ^{131}I for thyrotoxicosis was investigated. The 68 thyrotoxic patients were divided into four groups; those treated with antithyroid drugs alone, antithyroid drugs plus thyroxine, radioiodine alone, and radioiodine plus thyroxine. Exophthalmos was measured before treatment began, when the patient became euthyroid, and three months later an increase in the exophthalmos was recorded in the first three groups. In the fourth group, treated by radioiodine plus thyroxine, no significant change occurred. The 16 patients in group four were, on average, euthyroid by 11 weeks. This is not significantly different from the time of becoming euthyroid in group three. At this time the exophthalmos had decreased in four, increased slightly in five, and remained unchanged in seven. The mean change from the control value, -0.3 ± 0.75 mm, was not significantly different from zero. Three months later exophthalmos showed a decrease in five, a slight increase in five, and no change in six. The mean change, $+0.1 \pm 0.71$ mm, was again not significantly different from zero. Although thyroxine afforded protection against increase in exophthalmos in patients treated with radioiodine, the reason for this is not clear. Patients treated with radioiodine were on average older than those treated with antithyroid drugs, but there was no significant difference between the pretreatment exophthalmometer readings in any of the groups studied. It is possible that antithyroid drugs may interfere with the peripheral action of thyroxine, and it has been shown that thiouracil compounds inhibit deiodination of thyroxine, but there is no evidence that this applies to perchlorate. There is evidence that radioiodine-labeled thyroid hormones are concentrated in the pituitary. This might lead to diminished production of exophthalmos-producing substance, although this alone would not account for the difference between groups three and four. The thyroid radioiodine uptake is suppressed by the administration of exogenous thyroid hormone, in some cases as early as six weeks after administration of a therapeutic dose of radioiodine. There may, therefore, be two factors operating to prevent an increase in output of exophthalmos-producing substance: firstly, concentration of radioiodine in the pituitary gland, and, secondly, suppression by exogenous thyroxine. (BBB)

34013 MEDIASTINAL OBSTRUCTION BY RADIOTHERAPY. Robertson, Myra G. (Royal Free Hospital, London). Brit. Med. J., 1: 1248-9(May 8, 1965).

The use of demecolcine, as a mitosis-arresting agent, prior to radiotherapy has been recommended as a means of enhancing radiosensitivity of some types of tumors. However, some evidence is presented which indicates that the combination of irradiation and demecolcine may depress leukocyte and platelet levels. Two male patients with superior mediastinal obstruction due to lung cancer were treated with a 5-mg dose of demecolcine followed four hr later by deep x-ray therapy. Three days after starting treatment with a low daily maximum dose of 50 R at 230 kv, Case 1 had a prolonged epistaxis and was found to have thrombocytopenia, his platelets being 20,000 and 49,000 on consecutive days. The white blood count was within normal limits, 6000/mm^3. He died four days later, the cause of death being carcinomatosis and carcinoma of right lung. Case 2 showed no evidence of bleeding, but was found to have a platelet count of 26,000 and 52,000 on consecutive days after daily maximum doses of 100 R at 230 kv for 15 days. The platelet count subsequently rose to 85,000, but he developed intracranial metastases and treatment was stopped. His white blood count was 7600. Thrombocytopenia in cases treated with demecolcine and radiotherapy has been described, but in these cases it is not known whether the platelet count was already depressed prior to starting treatment or had become depressed as a result of the demecolcine or the radiotherapy, or a combination of both. Further, patients with this condition receiving radiotherapy should have their platelet counts measured, though formerly this was not routine practice during palliative radiotherapy at low daily doses. It is suggested that if demecolcine plus radiotherapy is undertaken for superior mediastinal obstruction, careful check should be kept on platelets as well as white blood cell count. (BBB)

34014 TRANSVERSE BANDS IN FINGERNAILS: SINGLE TRANSVERSE STRIATE LEUKONYCHIA OR MELANONYCHIA. Thomas, Henry M. Jr. (Johns Hopkins Univ., Baltimore). Bull. Johns Hopkins Hosp., 115: 238-44(Sept. 1964).

A case is reported in which transverse bands of pigment in the fingernails followed intensive irradiation of the thyroid gland. The relation of this change to irradiation and change in thyroid function is obscure, and this case is recorded in the hope that it may shed light on the mechanism of such nail abnormalities in pigmentation. (BBB)

34015 SUPERVOLTAGE RADIATION THERAPY: USE OF THE LINEAR ACCELERATOR FOR TREATING OVARIAN ADENOCARCINOMA. Sagerman, Robert H.; Hanks, Gerald E.; Bagshaw, Malcolm A. (Stanford Univ. School of Medicine, Palo Alto, Calif.). Calif. Med., 102: 118-22(Feb. 1965).

Dose data and radiation effects on the hematopoietic system, gastrointestinal tract, liver, and kidney are presented along with survival statistics following irradiation of 63 patients. The 4.8-Mev Stanford medical linear accelerator allowed a decrease in skin reaction, bone absorption, and integral dose, as well as delivery of a homogeneous dose of radiation throughout the entire volume of involvement. Sharp beam definition and accurate shielding enabled this while sparing vital organs such as the kidney.

Cure of ovarian adenocarcinoma is not possible with low doses of irradiation, so as large a tumor dose as was considered feasible was given without undue risk of damage to vital organs. In Stage 2 and 3 cases, a midplane tumor dose to 5000 to 5500 rad was delivered in five to six weeks, at about 200 rad per day, through anterior and posterior fields. In Stage 4 cases treatment to the entire peritoneal cavity was required. The upper abdomen was treated through directly opposing anterior and posterior fields to a midplane dose of 1500 to 2000 rad; then the kidneys were localized and protected by lead blocks 42 mm thick, and treatment with a four-field technique given until a midplane dose of 3500 to 4500 rad had been delivered. The projected four-yr survival rate was 60% in Stage 2, 73% in Stage 3, and 15% in Stage 4. Pelvic irradiation was accompanied by a reduction in the white blood cell count below 3000 cells per mm^3 in only 18% of the patients. Irradiation of the entire abdomen resulted in a significant further reduction of the leukocyte count; 60% of the min values were below 3000. Depression in the leukocyte count was not associated with an early complication, and in no case was it necessary to interrupt treatment for more than a day or two. For possible gastrointestinal effects two-thirds of the patients were given medication, for control of mild diarrhea and/or nausea, and pelvic irradiation was tolerated well. Reduction of the daily dose because of gastrointestinal upset was rarely necessary. Irradiation of the entire abdomen was not tolerated well, and all patients required medication for control of diarrhea and/or nausea with vomiting. In two cases, late bowel complications developed, requiring surgical intervention. Three patients died shortly after the conclusion of radiation therapy to the entire peritoneal cavity, with signs of hepatic failure, but no tumor could be demonstrated in the liver at postmortem examination. The histologic changes in the liver were present. The dose received by the kidneys was about 2000 rad in three weeks, but there were no cases of radiation nephritis and no significant changes were seen on histologic examination of the kidneys. (BBB)

34016 THE SURGICAL SIGNIFICANCE OF RADIATION INJURIES TO BOWEL. Sterns, E. E. (Queen's Univ., Kingston, Ont.); Palmer, J. A.; Kergin, F. G. Can. J. Surg., 7: 407-13(Oct. 1964).

The pertinent literature is reviewed and 54 of the authors' cases of radioinduced intestinal injuries are surveyed in an attempt to discover the most satisfactory means of management of the more serious aspects of this problem, especially those that require surgical intervention. Incidence of radiation damage to bowel has been reported to be between 2% and 5% in patients receiving pelvic radiation. About 17% of those who sustained injury develop strictures and between 50% and 75% have some permanent residual rectal changes. Damage to the ileum following pelvic radiation has occurred in 0.6% to 1.5% of patients. Factitious proctitis, or radiation injury of the sigmoid colon and rectum, produces two different pathologic states. The first is the intrinsic reaction that occurs within the rectal or bowel wall and consists of hyperemia and edema appearing within days of radiation. In three to four weeks, granulomatous inflammation and ulceration develop. Fistulas may occur later. Delayed healing, characterized by fibrosis, leads to stenosis after a variable period. The second form is an extrinsic reaction which occurs in the perirectal connective tissues. Fibrosis with resultant extrinsic compression, and endarteritis with resultant ischemia, affect the bowel wall secondarily. The connective-tissue mass so formed may suggest the presence of diffusely recurrent malignant disease throughout the pelvis. Although the entire gastrointestinal epithelium is vulnerable to radiation, the small bowel mucosa appears to be more sensitive. However, the ileum is mobile and infrequently fixed by pelvic adhesions, which tends to protect it from more common injury. Excessive or a too-concentrated course of radiation apparently is the most important cause of injury. Other etiologic factors may be errors in technique of administration such as dislodgement of radium applicators, a retroverted uterus, or pre-existing pelvic inflammatory disease. Some patients' tissues appear to react excessively to a standard and properly applied course of radiation. In one follow-up of 500 consecutive patients treated radiologically for carcinoma of the cervix, mild mucosal changes were noted in 14% and more advanced lesions, such as necrosis, ulceration and moderate stenosis, occurred in 7%. Only 1% developed more severe stenoses or fistulas requiring operative intervention. A rectal dose below 4000 R resulted in significant damage in 1.6%. As the dosage increased above 5000 R, an increased incidence of complications occurred. When external radiation was added to interstitial radium, no rectal lesions were noted if the total rectal dose remained below 4000 R, but became appreciable if it were increased to 6000 R or more. Time of onset, clinical symptoms, and treatment of radioinjured bowel are also described. Surgical treatment of severe complications of radiation ileitis, colitis, and proctitis is controversial, but there is general agreement that the early manifestations may be temporary and self-limiting and can be adequately managed by a regimen of bland diet, antispasmodics, antibiotics, and sedation. The indications for surgical intervention in chronic radiation proctosigmoiditis include persistent severe pain, bleeding, obstruction, incipient perforation, and diversion of the fecal stream from nonhealing ulcers and fistulas. In the authors' series the first symptoms of radiation injury experienced by 11 patients coincided and occurred within 30 days, and each sustained serious injury requiring hospitalization and in some cases operative intervention. Thus the early reaction is not always benign. In the remaining 43 patients, the onset of symptoms was delayed with an average interval between termination of radiotherapy and onset of 17.3 months. The greatest delay in onset was 13 yr. The most prominent clinical feature was obstruction, dominant in 40 of the 54 patients. Rectal bleeding was common but generally not severe. Bleeding was sufficiently massive and persistent to warrant colostomy in only one patient. In nine patients, death was attributed to the effects of radiation; in four, to such effects in the absence of malignant disease; and in five, to these effects in the presence of co-existing malignant disease. In four of the 19 patients who died, death could be ascribed to the effects of radiation on the small or large bowel. Three patients died as a result of perforation of necrotic bowel and one from the effects of an intestinal-vaginal fistula. In 28 of the 54 patients, operative intervention was required because of complications of radiation injury to the intestine. More than one operative procedure was necessary in 11. These surgical procedures are described. If technically feasible, a wide resection of the damaged small or large bowel is advised. Bypass, in the present experience, was unsatisfactory, whereas primary resection gave good results. (BBB)

34017 EFFECTS OF IRRADIATION ON LUNG FUNCTION. Wellington, J. L.; Lynn, R. B. (Kingston Cancer Clinic, Ontario). Can. Med. Assoc. J., 90: 1341-4(June 13, 1964).

An attempt was made to determine whether ^{60}Co irradiation of intrathoracic structures (for carcinoma of the lung) was followed by more severe changes than those which ensued when the chest wall was irradiated (for carcinoma of the breast), and whether there was any correlation between symptoms, radiological changes, and lung function. Of the 32 cases analyzed, 20 were patients with carcinoma of the breast and 12 had carcinoma of the lung. Eighteen of the 20 breast cancer cases received radiation in doses of 4000 to 5000 R over a four-week period, with treatment of the supraclavicular area, apex of axilla, and internal mammary chain. The two remaining patients received 15,600 and 11,400 R because of local tumor recurrence. In the other group, by rotational or parallel opposing techniques a tumor dose of 5000 to 8000 R was delivered over a four- to six-week period. Before irradiation and at intervals of three, six, nine, and 12 months thereafter, the following studies were carried out: (1) clinical symptomatology; (2) postero-anterior radiographs of the chest; and (3) pulmonary function tests. Vital capacity (VC), timed VC, and maximal breathing capacity (MBC) as well as inspiratory

capacity and expiratory reserve volume were obtained. The functional residual capacity and residual volumes were determined by He dilution techniques. Arterial blood samples were analyzed for pH, PCO_2, O_2 saturation, and standard bicarbonate. Of the 20 patients with breast carcinoma, ten developed irradiation pneumonitis seen radiologically. In nine this became apparent within three months, and in one within five weeks. Five patients developed altered lung function, three within three months and the remainder within the year. The MBC was mostly affected, but the patient who received 15,600 R for recurrent carcinoma showed a significant reduction in VC. Only three patients had symptoms, in two a nonproductive cough. Both had pneumonitis but only one had impaired pulmonary function. The third patient, who received 15,600 R, developed severe dyspnea. Radiographic changes characteristic of pneumonitis developed in seven of the 12 patients with lung cancer (within three months in five patients and in the remaining two within six months). In two patients cough and dyspnea progressed. It is concluded that ^{60}Co therapy to the chest wall or intrathoracic structures may measurably damage lung structure and function in some patients, but the degree of such damage does not detract from the value of this form of treatment as an adjunct to surgery in the treatment of cancer of the breast or as a palliative measure for patients with cancer of the lung. (BBB)

34018 A STUDY ON MORBID ANATOMY OF ^{60}Co-IRRADIATED SQUAMOUS CELL CARCINOMA OF THE ESOPHAGUS. Sun, Shao-chien; Hsia, Wu (Fu Wai Hospital, Chinese Academy of Medical Sciences, Peking). Chinese Med. J., 83: 497-505(Aug. 1964).

Histologic changes of 80 surgical specimens of squamous cell carcinoma of the esophagus which had been irradiated preoperatively with various doses of ^{60}Co were studied. The specimens could be classified into three groups according to the degree of tumor tissue destruction: Group R_1 23 cases, Group R_2 22 cases, and Group R_3 35 cases. The morphologic criteria of this classification are described as mild, moderate, and severe. The tissue dosages in the three groups were R_1 1000 to 3650 R, R_2 1500 to 4980 R, and R_3 2100 to 7000 R. In most cases, there was a definite correlation between the tissue dosage of ^{60}Co and the degree of destruction of the tumor. The number of cases in Groups R_2 and R_3 increased as the tissue dosages exceeded 3000 R. No case of Group R_1 type was observed when the tissue dose was larger than 3900 R while no case of Group R_3 was noted when the tissue dosage was less than 2000 R. This could be explained on the basis of individual variability of radiation response. The cancer cells revealed degeneration, necrosis, disintegration, and keratinization. The degenerated cancer cells appeared swollen, and intracytoplasmic and intranuclear vacuoles were frequently seen. The nuclei were frequently enlarged, deeply stained, and variable in size. The chromatin granules were no longer distinct. The nuclei had become darkly and homogeneously stained irregular masses. Masses of concentrically arranged keratinized material were frequently seen in the central portions of sheets of cancer cells. Phagocytes and foreign-body giant cells engulfing keratin particles were seen. These keratinized masses were usually disintegrating and sometimes calcified. Aggregations of polymorphonuclear leukocytes were frequently seen within sheets of degenerated cancer cells. (BBB)

34019 COMPLICATIONS FOLLOWING MEGAVOLTAGE RADIATION FOR CARCINOMA OF THE BLADDER. Edwards, D. N. (Liverpool Regional Radiotherapy Centre, Eng.). Clin. Radiol., 16: 27-33(Jan. 1965).

Radioinduced injuries that occurred among 141 patients treated for bladder cancer with megavoltage radiation from a 4-Mev linear accelerator are described. Treatment was either radical or palliative. Radical treatment was a mean tumor dose of 5000 rad over 22 days; for palliation a mean tumor dose of 2000 rad was delivered in two sessions with 24 hr. All treatments were planned using a simulator unit. Treatment was given by three fields at 120°. The factors which may produce complications following radiotherapy were examined, especially the treated volume and dose. (TCO)

34020 THE POSITION OF MEGAVOLT THERAPY IN PRESENT DAY USE OF IRRADIATION. Bauer, R.; Feine, U. (Universitaet Tuebingen, Ger.). Deut. Med. Wochschr., 89: 2113-17(Nov. 6, 1964). (In German)

The use of ultrahard x irradiation and γ irradiation at energies above 1 Mev is compared to use of conventional x irradiation. Advantages of using ultrahard x irradiation were found to be: less skin damage, greater depth dose, more homogenous tumor dose, smaller volume dose, and less bone damage resulting from absorption of irradiation energy. Out of 818 cases treated with 15-Mev electrons, the five-yr survival rates were 43.8% for laryngeal tumors, 30% for thyroid tumors, 14.2% for tumors of the oral cavity, 51.5% for skin tumors, 31.5% for melanomas, and 38.8% for parotid tumors. In treatment of deep lying tumors, such as bronchial, esophageal, or ureteral carcinomas, good palliative effects were observed more frequently than with conventional x irradiation. Early results were more favorable, but effects appearing after 3 to 5 yrs were very similar to those that appeared after conventional x irradiation. The optimal tumor dose for fast electrons was determined to be from 5000 to 6000 R. Generally, treatment of malignant tumors with fast electrons did not constitute a prognostic turning point. Rather, it represented important progress in irradiation treatment. (TCO)

34021 ON THE EFFECT OF RADIATION INJURY ON TEMPEROMANDIBULAR ARTICULATION AND ITS TREATMENT. Grimm, Gerhard (Martin-Luther-Universitat, Halle/Saale, Ger.). Fortschr. Kiefer-Gesichtschir., 8: 166-71(1962). (In German)

A survey showed that there is little information available concerning damage to joints produced by ionizing radiation. The first reported case of bony ankylosis of the temperomandibular joint following deep x-ray therapy for a carcinoma of the epipharynx in a 14-yr-old boy is described. Lying in the direct x-ray beam, each temperomandibular joint received over 11,000 R during two series of treatments. Several months after the end of treatment there was increasing difficulty in movement of the lower jaw which progressed to complete immobility of the mandible, with loss of teeth in two yr. Radiologically it was possible to observe the formation of a bony bridge across the joint on the left side. On the right side the joint space was severely narrowed. Increasing difficulty with nutrition forced surgical treatment, and this was carried out under a broad-spectrum antibiotic administration to avoid development of radiation necrosis. After dental treatment a new joint was fashioned on the lest side; this resulted in some mobilization of the jaw and therefore the right mandibular head and condyle were removed. The immediately increased mobility was maintained by intensive postoperative exercises. Despite marked atrophy of the alveolus, chewing could be carried out with a prosthesis. Furthermore, it became possible to examine the throat for evidence of recurrence of the original lesion. Histologically the resected mandibular head showed the various features of radiation-induced damage to bone. These included atrophy of bone and areas of osteoporosis. (BBB)

34022 SOME UNCOMMON TUMORS OF INFANCY AND CHILDHOOD. Sirat, M. V. (Tata Memorial Hospital, Bombay). Indian J. Child Health, 10: 7-12(Dec. 1961).

A four-yr-old child irradiated with two 2050-R doses for a Ewing sarcoma six yr later developed a chondrosarcoma of the femur, which was considered to be probably radioinduced. (BBB)

34023 IRRADIATION WITH LOCALLY LIMITED RADIATION EFFECT (CLASSIC RADIUM THERAPY, SHORT-DISTANCE IRRADIATION, ARTIFICIAL RADIOACTIVE ISOTOPES). Schlungbaum, W.; Krokowski, E.; Ernst, H. (Freie Universitaet, Berlin). Internist, 5: 284-92(1964).

A general survey is given of the treatment methods using radium, x radiation, and radioisotopes. (C.H.)

34024 ACQUIRED DENTAL DEFECTS AND SALIVARY GLAND LESIONS AFTER IRRADIATION FOR CARCINOMA.

Frank, R. M.; Herdly, J.; Philippe, E. (Faculte de Medicine, Strasbourg). J. Am. Dental Assoc., 70: 868-83(Apr. 1965).

Dental defects and salivary gland injury were studied in 61 patients, 59 of whom had been treated by a ^{60}Co teletherapy unit for carcinomas of the oral cavity, oro- and nasopharynx, hypopharynx, and larynx. When irradiated with the ^{60}Co teletherapy unit, the salivary glands usually received 5000 to 6000 R on each side. The results showed that in all patients who had dental defects acquired after radiation therapy the salivary glands were in the field of irradiation. To evaluate the eventual relation existing between the dental lesions, the saliva, and the salivary glands, the dental defects acquired after irradiation and the saliva and salivary gland conditions observed in this group of patients are compared. The three types of dental defects which develop when the salivary glands of patients with carcinomas are irradiated are described. Histologically, these dental lesions are similar to dental caries but they differ from this disease by the diffuse localizations of the defects on the buccal, palatal, or lingual surfaces and the incisal or occlusal edges, which normally are spared by caries. When the salivary glands are not irradiated directly, even when the jaws and the teeth are in the field of radiation, no dental defects developed three years after ^{60}Co teletherapy. The quantitatively highly reduced saliva becomes viscid, acid, white, or yellow-to-brown, with an increased total nitrogen content. The salivary glands undergo typical changes consisting mainly of an involution of the serous cells followed by an involution of the mucous alveoli. This process develops progressively several months after irradiation. The result is a pronounced glandular atrophy. Some dental defects acquired after irradiation have a casual relation with the pathologic changes observed in the saliva and the salivary glands. The problem of teeth extractions after irradiation is discussed, and the problem of teeth extractions before radiotherapy as a preventive measure is reappraised in the light of these results. It is concluded that the radiotherapist should carefully avoid salivary gland irradiation and use protection systems every time it is technically possible. (BBB)

34025 DERMATOLOGIC CARE OF THE PAINFUL FOOT. Montgomery, Royal M. (Hospital for Special Surgery, New York). J. Bone Joint Surg., 46A: 1129-36(July 1964).

Treatment of various types of benign lesions on the foot with radiation is considered, with emphasis on shielding of healthy tissue, doses used, and development and treatment of radiodermatitis. Characteristics of plantar radiodermatitis are described. Since x-ray or Ra therapy given for corns, warts, or calluses is the cause of all plantar radiodermatitis, it usually occurs under bone prominences where pressure caused the original lesion. Large areas of plantar radiodermatitis like those found on other parts of the body show erythema, telangiectasia, atrophy, hyperkeratosis, ulceration, and pain. Smaller areas of one cm or less are difficult to distinguish from warts or corns since they are covered with a hyperkeratotic mass, and differential diagnosis can only be made after paring. This uncovers a corelike mass which has a diffuse border that blends into the surrounding tissue. In severe cases of radiodermatitis, removal of the keratotic tissue reveals a small ulcer or a soft area composed of many small sinuses which resemble a honeycomb. These areas may or may not be surrounded by erythema or telangiectasis. Larger, more heavily irradiated areas may show ulceration and cause intense pain. This pain persists even with elevation of the foot. Secondary infection may be present with erythema and edema. Ulcers may be one cm or larger in diameter. They may be round or linear in contour, and the base is often necrotic. Erythema and telangiectasia surround the ulcers. There is destruction of the underlying fat pad. When this is extensive, there is deep fibrosis in the involved area and the skin is fixed to the underlying structure. Conservative treatment is recommended for small areas of radiodermatitis with or without ulceration and little pain. The hyperkeratotic tissue is pared to the active blood vessels, and ointments are applied containing antibiotics. Silver nitrate solution, 10 to 25%, may be used also. With ulceration, bed rest and antibiotics orally or intramuscularly are necessary. If infection is present, the patient should be hospitalized. For ambulatory patients protective pads of felt or foam rubber may be strapped to the foot; such pads fixed in the shoe remove pressure and prevent further damage. When radiodermatitis resistant to conservative treatment or ulcerations larger than 0.4 cm in dia are accompanied by persistent pain, surgical treatment is indicated. Plastic surgical repair should include excision of areas of radiodermatitis including a margin of apparently healthy tissue. Free full-thickness or pedicle graft may be used to cover the defect. More extensive surgery may include removal of the metatarsal head or the entire ray including the area of radiodermatitis. (BBB)

34026 FEMORAL HEAD AND NECK RESECTION. Murray, William R.; Lucas, Donald B.; Inman, Verne T. (Univ. of California, San Francisco). J. Bone Joint Surg., 46A: 1184-97(Sept. 1964).

Loss or removal of the femoral head and neck is described as a final result in 37 patients, in three cases as a result of postirradiation necrosis. One patient, 19 yr earlier, had received radiation therapy for squamous-cell carcinoma of the cervix. Roentgenograms revealed radiation necrosis of the proximal end of the left femur and acetabulum, and examination showed the hip to be fixed at 20° of flexion, 20° of external rotation, and 20° of adduction. All attempts at motion from this fixed position were extremely painful. Resection of the head and neck was performed to restore motion. A second case had radiation treatment for squamous-cell carcinoma of the cervix 10 yr before. Pain developed in her right hip, and she became bedridden because of bilateral hip pain. Physical examination revealed both hips to be fixed at 10° of abduction, 40° of flexion, and 10° of external rotation. Roentgenograms showed radiation necrosis and intrapelvic protrusion of the femoral heads. Femoral head and neck resection was performed on both hips. This procedure, it is suggested, should be used only as a salvage operation limited to situations in which replacement or interposition arthroplasty, arthrodesis, or osteotomy is not feasible. It is indicated in postirradiation necrosis of the hip in patients not suitable for arthroplasty or arthrodesis, in whom arthrodesis or arthroplastic procedures were expected to fail because of bone necrosis in the pelvis and in the femoral head and neck. The procedure is technically simple and the morbidity negligible when compared with that after arthroplasty or arthrodesis. The femoral head and the entire femoral neck are removed down to the intertrochanteric line. The operative approach varies with existing conditions. In primary resections, a modified iliofemoral approach is preferred. An H-shaped capsular incision is made, the neck is transected, and the head is removed. It may be necessary first to remove a section of the neck to facilitate removal of the head. The remainder of the neck is then removed as far distally as the intertrochanteric line, with care taken to remove all spicules of bone and leave as smooth a surface as possible. The capsular incision is then closed. All patients except those with infections began to walk in not less than ten days and not more than three weeks after operation. The procedure restored function to a high level and permitted rehabilitation of patients with incapacitating disabilities; 92% were free of pain, and the others had slight pain which was not sufficient to require analgesics and did not limit activity. The major disadvantages are limb shortening and need for external support. There was shortening ranging from $\frac{3}{4}$ to two in., with an average of 1.3 in. (BBB)

34027 THE USE OF RADIOISOTOPES IN ORTHOPAEDICS. PART III. EXPERIMENTAL AND CLINICAL STUDIES. Ray, Robert D.; Mueller, Karl H. (Presbyterian-St. Luke's Hospital, Chicago). J. Bone Joint Surg., 47A: 417-27(Mar. 1965). (TID-21341)

A review is provided of applications of bone-seeking isotopes in qualitative and quantitative distribution studies and in dilution, circulation, and kinetic studies. An appendix is provided which shows an application form for prospective use of radioisotopes by investigators. Problems in applying

and interpreting autoradiographic studies of bone are considered, including: (1) loss of histological detail and dislodgement or displacement of the tracer, and (2) artefacts caused by chemical reactions between tissue and emulsion, background radiation, static electricity, distortion of the emulsion, and localization of the isotope with reference to its exposed image. Some assumptions underlying the method may not prove to be valid. An example of quantitative distribution studies is cited in which the plasma concentration of ^{89}Sr and its accumulation in bone, as well as its loss from the body in the urine and feces, is determined by sacrificing groups of animals at intervals and counting the radioactivity in tissues and excreta. Although this type of study is not feasible under clinical conditions, γ-emitting isotopes and scintillation detectors make it possible to follow the distribution of an isotope or a compound in the body by surface counting. Modifications of this technique using ^{85}Sr are helpful in localizing metastatic tumors in bone, in following the response of patients to treatment, and in studying the local turnover of Ca after fractures. In attempts to assess the circulation of the head of the femur following a fracture of the femoral neck, three different methods have been proposed. In the first, the relative amount of a bone-seeking isotope such as ^{32}P accumulated during a fixed time interval is determined by inserting a Geiger counter first into the head of the femur and then into the trochanteric region. The ratio between the two counts thus obtained has been used to estimate whether or not the circulation to the head has been damaged. In the second method, the circulation time to the head of the femur and the rate of accumulation of counts is determined using a beta emitting blood-bound isotope (^{32}P-labeled diisopropylphosphate) and a special type of Geiger counter. The third method is based on the rate of mobilization of a gamma-emitting isotope such as ^{23}Na or ^{131}I-tagged albumin from the head of the femur following intraosseous injection. Another method for the experimental study of bone circulation, is based on the Fick principle (blood flow to a tissue or organ equals the amount of a substance cleared by the tissue divided by the arteriovenous difference). Thus, during the first five min after administration of ^{45}Ca, ~50% of the blood flowing through bone is cleared by bone uptake. Bone blood flow can be determined by injecting a predetermined amount of isotope through a cannula placed in the nutrient artery of the bone and then collecting venous samples. The amount of isotope returning from the bone can also be determined by cannulating the main metaphyseal effluent vein. In both methods, some isotope remains in the blood contained in the marrow, and a correction must be made for this. To determine the relative blood volumes of marrow, as well as bone, a double isotope technique can be used involving a blood-bound isotope such as ^{51}Cr-tagged red cells and a bone-seeking isotope such as ^{45}Ca. Several kinetic studies with isotopes are also described along with examples of clinical uses. Assumptions on which kinetic studies are based are discussed. In the clinical use of radioisotopes, for calculating the radiation dosage or exposure to the patient, it is important to take into account the type of emission and half life of the isotope, as well as the biological life and distribution of the isotope in the body. This accounting is difficult since bone turnover is rapid in some parts of the skeleton, while in others extremely slow. Thus, most estimates of radiation damage are based on the total amount of isotope administered, rather than the retained dose, and on an infinite biological lifespan in the body. A form that has been found useful for dose estimation is illustrated in the appendix. (BBB)

34028 SYMPOSIUM ON CARCINOMA OF THE CERVIX UTERI. (3) THE COMBINATION OF SURGERY AND RADIATION IN THE TREATMENT OF UTERINE CERVICAL CANCER. Nelson, Alan J. M. (Royal Perth Hospital, Perth, Australia). J. Coll. Radiologists Australasia, 8: 117-22(June 1964).

Use of irradiation, with or without surgery, in the eradication of this disease is considered, with data on optimal techniques and doses. It is recommended that total removal of the uterus should take place one month after a course of Ra to the primary tumor and supervoltage irradiation to the parametrial tissues. To achieve this, close attention must be paid to radiotherapeutic technique and dosage. It is suggested that this might be a standard treatment for operable cancer of the cervix, and that the operation be omitted when the cervix has obviously healed. The key assumption is that irradiation of the parametrium and regional glands will eradicate the cancer in these sites as effectively as surgical dissection. This is supported by the favorable experience gained by comparing the results of surgery and irradiation for the regional glands of cancer of the breast. Although the advent of supervoltage has produced the improvement of treatment results, and although it is favored because of its technical superiority, it is the dose level rather than the supervoltage which is the important factor. It is the control of tumor in the lymph glands which affects the results; supervoltage cannot contribute any similar advantage in the control of recurrences in the primary site. It appears that optimum dose, rather than the method of delivering that dose, is important. In some cases, where Ra treatment alone is indicated, no difference in the results obtained whether or not x-ray treatment is added, if the total dose to pericervical tissues is the same. Persistence of cancer in the cervix is the most frequent cause of failure in radiation therapy. There is no sure way of deciding which cases will be completely sterilized by radiation, so that routine prophylactic hysterectomy is considered advisable. In the earlier stages, tumor deposits in lymph glands will be small and well-vascularized and susceptible to the optimum cancericidal radiation dose. In cases of persistent primary cancer, the presence of anoxia within the tumor may decrease the radiosensitivity of groups of cells by a factor of 2 or 3, which permits a few cells to survive after even high doses of radiation. The persistence of cancer cells in bulky tumors, and the tendency of massive and semi-necrotic cancers of the cervix or the infiltrating scirrhous endocervical tumor to recur after radiation, is well known. Several cases in which injury of pelvic organs followed radiotherapy are briefly mentioned. (BBB)

34029 PLACENTASCAN AS A DIAGNOSTIC AID: REPORT OF 14 CASES. Sutherland, J. Patrick (3646th U. S. Air Force Hospital, Laughlin AFB, Tex.). J. Kentucky State Med. Assoc., 62: 761-4(Oct. 1964).

The technique of placenta scanning utilizing ^{131}I-tagged human serum albumin is presented, emphasizing its simplicity, accuracy, and safety. The advantages and disadvantages are also discussed. The results in 14 cases are presented with one case of total placenta praevia being reported in detail. The theory upon which placenta scanning is based is the slow diffusion from the vascular compartment of the relatively large albumin molecule tagged with ^{131}I. The distribution is physiological, and it can be assumed that one of the highest concentrations found in the vascular compartment will be at the site of placental implantation. In all instances, a scintillation counter with automatic timer was used, employing a counting head having a two-cm opening. The counting head was placed flush against the skin in the area to be scanned. Prior to the placenta scanning the patient was administered ten drops of Lugol's solution in water. If delivery was not carried out within a matter of several hours, the same dose of Lugol's solution was repeated three times a day for three days. This was done to block any possible uptake of the ^{131}I by the thyroid of the fetus. However, studies of cord blood and the thyroid of the infant failed to reveal any evidence of ^{131}I uptake, even when Lugol's solution had not been administered. With the patient in the supine position, the skin overlying the uterus was marked off into nine equal areas. Five μC of ^{131}I albumin was then injected into an arm vein. After allowing ten min for equilibration, a one-min count was taken over the xiphisternum and the nine outlined skin areas. There are several advantages of placenta scanning over other procedures for the localization of the placenta. Most important is that vaginal examination, with its potential hazards, is avoided. Secondly, the amount of irradiation received by both the mother and

infant is much less than that resulting from x-ray studies. Allowing for total decay of the ^{131}I, the maximum fetal radiation dose is ~70 mR. This represents about one-tenth the radiation exposure from a single x ray of the abdomen. As regards the maternal irradiation exposure, 5 μC of ^{131}I is only one-eighth the average dose utilized in diagnostic thyroid uptake studies. The accuracy of this technique is another strong advantage, being well above 90%. In contrast, the accuracy of other methods of placentography ranges from 75 to 95%, depending upon the technique employed. The main disadvantage of placenta scanning is its unreliability when carried out prior to the 34th week of gestation; however, with advances being made in the equipment, the reliability of the procedure may be expected to improve accordingly. Even at this time the results obtained are more reliable than those furnished by any other technique. (BBB)

34030 EXPERIENCES WITH RADIOACTIVE GOLD IN THE TREATMENT OF CRANIOPHARYNGIOMA. Bond, William H.; Richards, David; Turner, Eric (Queen Elizabeth Hospital, Birmingham, Eng.). J. Neurol. Neurosurg. Psychiat., 28: 30-8(Feb. 1965).

Histologic studies showing radiation-induced tissue injury, dosimetry considerations, and tumor radiosensitivity results are reported in five patients treated with ^{198}Au. In colloidal form it emits 95% of β radiation with 0.96-Mev energy, and 5% of γ radiation with 0.41-Mev energy. The maximum penetration of the β particles is 3.8 mm and the half value layer 0.3 mm. Assuming a cyst capacity of about 50 ml, it appeared to a first approximation that 100 mC would not exceed brain tolerance at a depth of 1.0 cm, although the cyst lining would be receiving a dose in excess of 20,000 R. This dose was felt to be high enough to cause complete destruction of the epithelial lining; a useful dose of the order of 1000 R β and 5000 R γ would be received at a depth of 1.5 mm but at a depth of 1.0 cm the dose would be entirely γ radiation and under 2000 R. This calculation of dosage could only be approximate, for it was impossible to estimate accurately the capacity of a cyst, or the degree of dilution of the injected radioactive material by residual fluid left after aspiration. The instillation of ^{198}Au was used in the treatment of five cases of craniopharyngioma, which were studied at post-mortem examination. Evidence was presented that the instillation of a dosage of 50 to 100 mC may damage brain tissue as well as destroying the cyst wall, and it was concluded that this dosage is excessive. If local instillation is used, it is recommended that the dosage should be confined to about 10 to 15 mC. Before local treatment is undertaken, however, careful consideration should be given to external radiotherapy. There may yet be a useful place for the method of local instillation of ^{198}Au where the tumor consists of one or more large cysts which are accessible. Such a method could conceivably be combined with external irradiation or be followed by local irradiation. Experience with colloidal ^{198}Au at other sites suggests a possible explanation of the high dose effects noted in this series in that a specimen of pleural effusion or ascitic fluid taken three days after injection of 300 mC showed an unexpectedly low level of radioactivity, and it is believed that the colloidal nature of the radiogold is lost soon after injection. The material lost from suspension accumulates evenly or unevenly on the lining. Such a change will have no effect on the γ dose at a depth of more than 3.8 mm but will markedly increase the β radiation dose within this distance, especially should the material accumulate in an irregular fashion. Even so it was difficult to explain the brain injury seen at a depth of more than 0.5 cm from the lining of a 4.0 cm cyst as a pure effect of radiation. (BBB)

34031 THE EFFECT OF ROENTGEN-RAY THERAPY ON OLIGODENDROGLIOMAS OF THE BRAIN. Shenkin, Henry A. (Episcopal Hospital, Philadelphia). J. Neurosurg., 22: 57-9(Jan. 1965).

The radiosensitivity and response to radiation of 15 oligodendrogliomas were evaluated, and a description given of injuries to brain tissue where they occurred. The frontal lobes were the predominant location (10 cases); there were two intraventricular tumors and three neoplasms of the parietal lobe. There was no postoperative mortality and none of the patients was reoperated upon. Five patients of the series were given immediate postoperative irradiation, and four of these were given second courses of irradiation when recurrence of the tumor was identified. Three ports were generally used, two opposing lateral and one frontal or occipital on the side of the lesion. In a few instances a fourth port, rostrally, was used. Treatment was delivered starting with 100 R in air and gradually increased to about 300 R in air daily to one of the ports in rotation five days weekly. In six patients who received no irradiation the average preoperative duration of symptoms was six months (range 2 to 12 months). Four of these patients have died. Five patients were given immediate postoperative x-ray therapy. One patient after 3000 R to the site of tumor through three ports, had a rapid onset of hemiplegia and then progressive debility ending in death five months postoperatively. Autopsy revealed no evidence of tumor in his brain but there were extensive areas of cerebral atrophy and gliosis, as a reaction to irradiation. The other four received full courses of deep x-ray therapy in tumor doses ranging from 4750 to 6500 R and all had evidences of recurrence of tumor at 24, 41, 68, and 20 months. They were all given second courses of irradiation ranging from tumor doses of 2000 to 3580 R and remission of symptoms resulted for an additional 24, 24, 54, and 48 months respectively, increasing the average total survival time in these four cases to 76 months (48, 65, 122, and 68 months). Four other patients were given irradiation for the first time when recurrence of tumor manifested itself postoperatively. Tumor recurred on the average 29 months, with hemiparesis in two instances and symptoms of increasing intracranial pressure in all instances. Each patient was then given irradiation in moderate dosages, ranging from 2500 to 4620 R, and prompt and unequivocal remissions were produced. These 4 patients are all still alive now 21, 48, 66, and 68 months following operation. It is concluded that oligodendrogliomas are sensitive to x-ray treatment. The evidence shows that irradiation alone induced remissions from the symptoms of recurrent tumor in eight patients. Postoperative radiation therapy for intracranial oligodendrogliomas should be delayed until there is clear evidence of recurrence of tumor. The unfavorable reaction to x-ray therapy with permature deterioration of the one patient's neurological status has also been encountered in the postoperative irradiation of other types of gliomas. Patients occasionally survive for prolonged periods without postoperative irradiation; it is therefore unwise to risk the complications of radiation therapy in individual cases before it is clear that the tumor removed at operation will recur. X-ray treatment delayed until recurrence is recognized probably is as effective in lengthening total survival time after operation as immediate postoperative irradiation followed by more irradiation when recurrence is recognized. (BBB)

34032 THE RELATIVE DOSAGE REQUIRED OF TOTAL BODY X-RAY VS INTRAVENOUS ^{32}P FOR EQUAL EFFECTIVENESS AGAINST LEUKEMIC CELLS OF THE LYMPHOCYTIC SERIES OR GRANULOCYTIC SERIES IN CHRONIC LEUKEMIA. Osgood, Edwin E. (Univ. of Oregon, Portland). J. Nucl. Med., 6: 421-32(June 1965). (TID-21880)

Data are presented which indicates that when comparisons are made at equal time intervals after the first dose, 1 mc of ^{32}P given intravenously is equivalent in effect to 15 R of total-body x-ray irradiation, as herein defined, in its effect on the leukemic cells of the lymphocytic or the granulocytic series in chronic leukemia. With this ratio, clinical therapeutic effects were equal, as well as effects on the total cell population of the involved cell series. For the effects measured there is a definite threshold below which, in each patient, leukocyte counts and spleen and lymph node size are not reduced. True radiation sensitivity of cell populations may differ greatly in different individuals and may change suddenly, either up or down, in the same individual at different times. (auth)

34033 FALSE POSITIVE BRAIN SCANS FROM EXTRACRANIAL CONTAMINATION WITH ^{99m}TECHNETIUM. Witcofski, Richard L. (Bowman Gray School of Medicine,

Winston-Salem, N. C.); Roper, T. J.; Maynard, C. D. J. Nucl. Med., 6: 524-7(July 1965).

Four cases of extracranial ^{99m}Tc contamination are discussed. Three resulted after oral and one after intravenous administration. Similar artefacts were intentionally produced by placing saliva on patient's heads. There would appear to be a greater possibility of a false-positive scan with the oral dose, however, due to concentration by the salivary glands and gastric mucosa, it cannot always be circumvented with the intravenous technique. (auth)

34034 CARCINOMA OF THE CERVIX ASSOCIATED WITH PREGNANCY: A SURVEY OF 84 CASES TREATED BETWEEN 1936-1962. Praagh, Van; Ian G. L.; Harvey, Miln H.; Vernon, C. P. (St. Luke's Hospital, New York, N. Y.). J. Obstet. Gynaecol. Brit. Commonwealth, 72: 75-80(Feb. 1965).

Problems encountered in the use of radiation and surgical procedures in treating cervical carcinoma during pregnancy are discussed with reference to 84 patients. Combined radiotherapy and surgery was utilized in resistant cases and in cases in which the initial prognosis was considered to be less favorable than in those that were treated by surgery or radiotherapy alone. There was no fetal survival in the 24 cases of carcinoma of the cervix diagnosed and treated in the first two trimesters. Diagnosis and treatment in the third trimesters. Diagnosis and treatment in the third trimester and in the first 12 months postpartum did not affect fetal survival. Results of radiotherapy were difficult to compare with those of surgery because of a higher incidence of advanced lesions and other complications of both the disease and previous therapy in the former group. (TCO)

34035 MEASUREMENT OF BODY FAT IN LIVING RATS WITH RADON. Hervey, G. R.; Moore, R. D. (Univ. of Aberdeen, Scotland). J. Physiol. (London), 176: 2P-3P (Jan. 1965).

An improved radioisotope method is described which has some advantages over an earlier method using ^{85}Kr, the disadvantages of which are discussed. Compared with the older nonisotopic methods, the radioactive tracer methods give the advantages of rapid assay and pharmacologically negligible concentrations, and an inert gas can be assumed to be present in simple solution in body water and fat. If an animal such as a rat is exposed to a gaseous tracer in a closed chamber or circuit, the volume of the air phase of the system is much larger, in proportion to the size of the animal, than the volume of a respiratory circuit to which a human subject is connected by a mouthpiece and valves. The solubility of Kr is 0.052 volumes per volume in water and 0.45 volumes per volume in fat at 37°C. A rat weighing 200 g and containing 10% of fat therefore has Kr spaces due to body water and fat of ~7 and 9 ml, respectively. Uptake by the animal would alter the concentration in the air phase of a circuit of any practical size by an amount too small for accurate measurement. A tracer with a higher solubility in fat is necessary to give a feasible method for small animals. Radon (^{222}Rn) has solubilities in water and fat of 0.15 and 19.5, respectively, at 37°C. The rat would therefore have Rn spaces due to water and fat ~20 and 400 ml, respectively. Measurement in a 1 to 1.5 l chamber or circuit should thus be possible with reasonable accuracy. There is a further advantage that the influence of body water is very small, and only a rough estimate of this is required. Radon is an energetic α emitter, but has the disadvantage that it decays to solid radioactive daughter products; the counting equipment must therefore be capable of discriminating α-particle energies. There is a further difficulty in that, since no stable isotope exists, the tracer has to be used in the absence of carrier, and the possibility of gas adsorption on to surfaces must be taken into consideration. Counting with 1% accuracy is possible with 1-4 μC of Rn in the system. (BBB)

34036 THE RADIOLOGICAL ASSESSMENT OF BLADDER TUMORS. PART 2. RADIOTHERAPY. Frank, H. G. (General Infirmary, Leeds, Eng.). J. Urol., 92: 484-9(Nov. 1964).

The use of implanted radioisotopes, 250-kv x rays, ^{60}Co γ rays, and 4-Mev electrons to treat 209 cases of bladder cancer is described, with emphasis on radiologic localization of the bladder, field planning, dose calculation, clinical results, and complications of irradiation. Typical treatment plans are shown. Isodose contours shown are expressed as percentages of the incident field dose. Also described is a combination of interstitial implantation with high energy radiation. A dose of 4000 R is given by the implant and a further 4000 R by high energy radiation over a period of 3 weeks after the wound has healed, usually about 3 weeks. No serious complications occurred in the 61 patients treated by high energy radiation nor were there any severe gastrointestinal complications. (BBB)

34037 INTRA-ARTERIAL CYTOTOXIC THERAPY FOR CANCER. Green, Anthony (Royal Northern Hospital, London). Lancet, 1: 276-7(Jan. 30, 1965).

Reasons for applying cytotoxic drug therapy before rather than after radiotherapy are advanced. Chemotherapy tends to increase radiosensitivity of tumors by increasing their vascularity. Two cases illustrating this principle are described. (BBB)

34038 RADIOISOTOPE SCANNING OF LUNGS. DeLand, Frank H.; Taxdal, David R. (Lakeland General Hosp., Fla.). Lancet, 1: 1224(June 5, 1965).

The use macroaggregated proteins labeled with radioisotopes, such as ^{131}I-macroaggregated serum albumin, to detect lung lesions is described with reference to one case report. The case report described is an example of the diagnostic information that this procedure can offer. A pulmonary scan was performed following intravenous injection of 300 μC of ^{131}I macroaggregated albumin. The concentration of isotope in the upper 2 to 3 cm of the right apex of the lung appeared decreased. Tomograms over this area showed a small, ill-defined lesion of the apex. A small lesion involving the apex and adjacent pleura was demonstrated by exploratory thoractomy and biopsy of the lesion revealed an anaplastic carcinoma. (TCO)

34039 X-RAYS AND PHILADELPHIA CHROMOSOME. Gavosto, F.; Pileri, A.; Pegoraro, L. (Clinica Medica dell'Universita, Turin). Lancet, 1: 1336-7(June 19, 1965).

A case of chronic myeloid leukemia in a patient with a history of considerable x-ray exposure where the Ph^1 chromosome could be observed in almost all bone marrow cells is reported. The patient, a man aged 49, had had bilateral tuberculous lesions and operations for extrapleural pneumothorax. The pneumothoraces were refilled weekly over a period of 5 yr. Each refill took place under fluoroscopic control, generally for more than a minute in duration. In addition, radiography and tomography were frequently performed for clinical control purposes. Therefore the total dose received by the patient was roughly estimated at not less than 5000 R about 5 to 10 yr previous to diagnosis of leukemia. After chronic myeloid leukemia was diagnosed, chromosome analysis was performed by the direct method on the bone-marrow cells. The modal number was 46 chromosomes, and in all observed mitoses the Philadelphia chromosome was present; no other morphological abnormality was found. Although a fortuitous relation between the intensive x-ray exposure and the appearance of chronic myeloid leukemia cannot be excluded in this case, it demonstrates the presence of the Ph^1 chromosome in a patient with a history of prolonged exposure to radiation. (BBB)

34040 CARCINOMA OF THE MAXILLARY SINUS WITH RESIDUAL THOROTRAST. Poushter, David; Perl, Theodore (Upstate Medical Center, Syracuse, N. Y.). Laryngoscope, 75: 74-83(Jan. 1965).

Three cases with residual opaque contrast material (Thorotrast) in the left maxillary sinus associated with carcinoma, are described. The first of three cases described here was a 42-yr-old woman exhibiting a hard, radiopaque mass on the left side of the nose. Biopsy showed squamous cell carcinoma, and the material taken from the sinus on spectrographic examination showed thorium present. She underwent extensive surgery and radiation therapy, but died of her disease within 18 months after its diagnosis. Case two, a 60-yr-old physician had had a long history of chronic

left maxillary sinusitis. Biopsy showed papillary carcinoma. The patient underwent radiotherapy and then extensive surgery, but died of the disease, five years after the original diagnosis. Careful attempts to determine the identity of the radiopaque material within the sinus were fruitless. In the third case, the 79-yr-old man had epidermoid carcinoma. The opaque material was checked for radioactivity and found to emit a short range particle, presumable α rays. Because of the extension through the posterior wall of the antrum, the patient was a poor candidate for surgery, and was treated with ^{60}Co radiation. It is suggested that in those patients in whom Thorotrast has been instilled in a body cavity such as a sinus, an attempt should be made to remove it. (TCO)

34041 GRID IRRADIATION OF THE WHOLE BODY IN THE TREATMENT OF LYMPHOGRANULOMATOSIS AND LEUKEMIA. Gyenes, Gyoergy (Orszagos Onkologiai Intezet, Radiologiai Osztalya, Budapest). Magy. Radiol., 17: 37-42(Feb. 1965). (In Hungarian)

A detailed report is made on 27 patients with lymphogranulomatosis (LGT) or leukemia in stage III or IV of the disease, in whom grid irradiation of the whole body was used with very satisfactory palliative results. This technique was applied to about 200 other patients prior to the present patients and the dose schedule recommended was single doses of 10 to 20 R repeated 10 to 20 times. The patients had reached the febrile-septic stage of the disease. Of the LGT patients receiving whole-body grid irradiation, regression of lymphoma was noted in 18 cases, fever was reduced in 13 cases, fluid accumulation in the chest or abdomen regressed in three cases, skin symptoms regressed in one case, and no change was noted in three cases. The general well-being of the patients improved and their blood picture improved. Only five leukemia patients received grid irradiation, and detailed data are presented only on one patient. The treatment in this case consisted of 5 × 30-R grid irradiation administered every other day. This reduced the number of circulating leukocytes from 120,000 to 25,000 per mm^3. Four years after the treatment he had no subjective symptoms and hematologic tests showed a red cell count of 4,200,000 per mm^3, hemoglobin 80%, and leukocytes 53,000. The following data compare the direct radiation exposure of open whole-body and grid irradiation: open whole-body exposure body volume: 170 cm × 20 cm × 20 cm = 68 liter; dose at 10 cm depth is 80% of surface dose, or 8 R; volume dose = 680,000 × 8 = 5,440,000 g-rad; and for grid irradiation, body volume = 68 liter; dose at 10 cm depth, 4 R; volume dose = 2,720,000 g-rad. Thus grid irradiation produces about one-half of the dose of the open method, and only about 1% of the lethal dose. It was concluded that this method can be successfully used even though the other method cannot. Because of the lower dose produced, this method could be used even when the patient was receiving chemotherapy, sometimes also permitting reduction of chemotherapy doses, resulting in less side effects. (BBB)

34042 TREATMENT OF MALIGNANT HAEMOPATHIES BY CHEMICAL DESTRUCTION. Carcassonne, Y. Marseille-Med., 101: 623-9(1964).

A detailed description is given of preparations that may be used in treatment of pathological conditions of the hematopoietic system. The four main groups include: classic radiomimetic compounds, such as arsenic, benzol, colchicine, urethane, and phenylhydrazine; recent radiomimetic compounds, such as caryolysin, R-48, chlorambutil, endoxan, degranol, novembiocin, dopan, sarcolysin, TEM, TEPA, thiotepa, trenimon, myleran, and para-aminobenzoic acid; antifolic compounds, such as aminopterin and amethopterin, purinethanol and similar compounds, leurochristin (oncovin), vincaleucoblastin, and azoserine; and chemical substances with physical effects, such as radio-phosphorus ^{32}P and radioactive arsenic, ^{76}As. The radioactive phosphorus emits β-rays and acts at short distance only; its biological action lasts about 11 days and acts in the same way as inorganic phosphorus. Its local destructive effect is mainly seen in the bone marrow, in young leucocytes, megakaryocytes and erythroblasts. Phosphorus-32 is generally administered intravenously, sometimes orally, and may be used in some forms of chronic myeloid leukemias, in polyglobulias, and in some forms of Hodgin's disease. Radioactive arsenic is a dermotropic agent. It may be utilized in cutaneous localizations of a tumorous process. (C.H.)

34043 SCINTILLATION SCANNING OF THE LIVER. Achaval, Alberto; Tauxe, W. Newlon; Gambill, Earl E. (Mayo Graduate School of Medicine, Rochester, Minn.). Mayo Clin. Proc., 40: 206-15(Mar. 1965).

An evaluation was made of the ability of liver scanning with ^{131}I-labeled Rose Bengal to reveal space-occupying lesions. The test was conducted in 14 normal subjects, 17 with cirrhosis, and 35 with other diseases affecting the liver. An estimate was made of the radiation exposure involved in this technique. A modified commercially available scanning device was utilized, which produced simultaneously a dot scan printed on a heat-sensitive paper, allowing immediate readout, and a photo scan made by a small light source projected onto film. The intensity of this light bears a nonlinear proportionality to the count rate of the isotope in the area being considered, and the density of the resultant spot thus affords an index of the functional mass of normal hepatic tissue under the detector. The first scan, which required 20 to 40 min to perform, was started ~10 min after the intravenous injection of Rose Bengal (200 μC of ^{131}I); in most cases a second scan was started from 45 to 60 min after injection. With normal liver the scans were interpreted as being normal in all cases; there were no false-positive results. The perimeter of a normal scan, obtained shortly after injection of Rose Bengal-^{131}I, outlines the anteroposterior projection of the liver; it follows closely the diaphragm and the lateral wall of the chest. No cold areas could be detected within the liver. In cirrhosis the uptake of radioactivity by the liver was slower and the maximal count rates were lower than normal. In normal cases the mean count rate 10 min after injection was 5600 counts per sec (range 3800 to 11,500). In cirrhosis the mean was 2600 (range, 450 to 3300). In these patients the radioactivity continued to increase at a time when the count rates in normal subjects were already decreasing. In most cases the organ was smaller than normal. The scans of 15 patients showed a peculiar finely mottled pattern, characteristic of the disease. Twenty-four scans in the 3rd group were diagnostic of space-occupying lesions (liver tissue was available for study in 21 cases), nine scans were suggestive of such lesions, and four scans gave falsely negative results. Of the 36 scans performed on patients with space-occupying lesions, 23 were diagnostic and nine were suggestive of such lesions. It is concluded that if hepatic scans are performed routinely before doing needle biopsies, the percentage of false-negative biopsies would be reduced. If there is no obvious impairment of hepatic function, nonvisualization of the gallbladder is an indication for further studies of the biliary tract. The method produces scans that are reproducible and can be utilized to follow the evolution of tumors and their response to treatment. The half-life of Rose Bengal in the circulation is 8.1 ± 2.2 min in normal persons. The ^{131}I is tightly bound to the dye and is excreted with it. Considering individual variations in intestinal transit time, it is reasonable to assume that the effective half-life of the isotope is from one to three days. An adult who received 200 μC will be subjected to a total-body radiation exposure of 0.04 to 0.12 R by β rays and to 0.027 R by γ rays. The radiation dose to the liver was estimated to be ~0.5 R. These levels are below those accepted as safe for other commonly employed diagnostic procedures: a roentgenogram of the abdomen requires 1.2 R and a gastrointestinal series, 0.65 R per film plus 0.28 R per sec of conventional fluoroscopy. (BBB)

34044 COMBINED OPERATIVE AND RADIATION TREATMENT OF JAW AND FACE CARCINOMA. Rosenthal, W. (Schloss-Klinik, Thallwitz ueber Wurzen, Ger.). Med. Bild, 4: 137-9(1961). (In German)

The irradiation of tumors of the facial region with doses up to 10,000 R is described, as well as the surgical procedures used to repair the defects caused by irradiation. (BBB)

34045 METABOLIC DISEASES OF BONE: KINETIC STUDIES. Ray, Robert D.; Mueller, Karl H.; Sankaran, Balu; Mensen, Ester D.; Schwartz, Theodore B. (Presbyterian-St. Luke's Hospital, Chicago). Med. Clin. N. Am., 49: 241-58(Jan. 1965). (TID-21142)

This study compared the kinetics of ^{85}Sr metabolism in normal subjects and in patients with generalized disorders of the skeleton, and also compared the results with those reported by other investigators. Data on 10 normal subjects from 11 to 65 years of age and 25 patients with generalized bone diseases are included. Patients maintained on a constant diet and kept under standard metabolic conditions were injected with carrier-free ^{85}Sr (15 to 30 μC). Urine, fecal, and blood levels of ^{85}Sr were followed for one week. Theoretical aspects of using radiostrontium to evaluate bone mineral metabolism are examined, with an explanation of the calculations involved. In normal subjects the mean value for the diffusable component or exchangeable pool was 20.57 ± 3.74 plasma volumes and the mean rate of clearance of ^{85}Sr from this pool by skeletal accretion 2.64 ± 0.74 plasma volumes per 24 hr. In adolescent subjects both values were increased. Values for accretion were decreased in hypoparathyroidism, hypophosphatasia, in one patient with Fanconi's syndrome, and in six patients with osteoporosis. The values were increased in vitamin D resistant rickets, Paget's disease, and hyperthyroidism. Normal values were obtained in five patients with osteoporosis, one with myxedema, and one with Fanconi's syndrome. Selection of appropriate tracers for bone metabolism studies and the possible hazards involved are discussed. It is desirable to use a tracer that is not metabolically bound, trapped or accreted by tissues other than bone. Both Sr and Ca approach this requirement although both are involved to some degree in other metabolic processes (muscle, nerve, and cartilage). Although Sr and Ca are handled differently by the intestinal tract and kidney, the values obtained for skeletal accretion are comparable. Stable Sr can be used successfully and has the obvious advantage of avoiding radioactivity. On the other hand, the techniques for analysis of radioisotopes are simple, rapid, and the equipment is available in most modern hospitals. A γ-emitting isotope is preferred because of simplicity of counting, the fact that it is possible to carry out surface surveys to compare one part of the skeleton with another, and because the risk of radiation damage to the marrow is minimized. This eliminates ^{45}Ca and narrows the choice at present to ^{47}Ca and ^{85}Sr. The short half-life of ^{47}Ca (4.7 days), the relative expense, and the fact that the isotope is delivered by the manufacturer infrequently were determining factors in selecting ^{85}Sr. With regard to possible radiation hazards involved, it is estimated that the total-body radiation dose calculated to infinite biological time and assuming the worst possible geometric distribution (a sphere) would be 1.05 rad for an injected dose of 10 μC. (As an occupational hazard, 5 rad a year total-body exposure is considered acceptable.) (BBB)

34046 RADIOIMMUNOASSAY OF HUMAN THYROTROPIN IN SERUM. Odell, W. D.; Wilber, J. F.; Paul, W. E. (National Cancer Inst., Bethesda, Md.). Metab. Clin. Exptl., 14: 465-7(Apr. 1965).

A sensitive, simple and precise radioimmunoassay for human thyrotropin (HTSH), capable of measuring HTSH in unextracted serum was developed. This report describes methodology and preliminary results. Antisera to highly purified HTSH were prepared in rabbits, and tested to obtain one suitable for use in an assay sensitive to less than 1 mμg of antigen. HTSH and this antiserum in immunoelectrophoresis formed a single precipitin line. HTSH was radioiodinated and the HTSH-^{131}I partially purified by passage through a Sephadex G-50 column; the initial peak of effluent radioactivity was used for assay purposes. Antibody-bound HTSH-^{131}I could be separated from non-antibody bound HTSH-^{131}I by chromatoelectrophoresis on DEAE paper or by differential solubility in alcohol-saline. The assay mixture included 100 μg of HTSH-^{131}I (0.1 to 0.3 mμg of HTSH-^{131}I or 0.03 to 0.09 μC ^{131}I and 100 μl of antisera to HTSH diluted appropriately in buffer (final dilution ranged 1 : 10,000 to 1 : 50,000 depending on antisera). The precipitated radioactivity was counted in a well-type scintillation counter and expressed as cpm precipitated. The log dose response curve for standard HTSH added to bovine serum shows that the entire dose-dependent area is encompassed in a 20-fold dilution of HTSH. A dose response curve of serum from a patient with primary myxedema demonstrates that plasma HTSH behaves similarly to standard HTSH. HTSH added to serum from hypophysectomized patients may be quantitatively recovered. This procedure was utilized to assay serum from 50 normal men and women and serum from patients with hypopituitarism, hyperthyroidism, and myxedema. Serum from normal men and women and 10 patients with hyperthyroidism contained less than 3.0 mμg TSH/ml. TSH was not detected (less than 2.5 mμg/ml) in 12 hypophysectomized patients. TSH levels were 10 to 150 mμg/ml in 9 patients with primary myxedema and fell to normal levels with replacement therapy. Treatment of a euthyroid patient with Tapazole for 7 days resulted in a 3-fold elevation of plasma TSH. Following administration of L-thyroxine intravenously, plasma TSH became undetectable within 2 hr. Since bovine TSH is not detected in immunoassay for HTSH, USP reference standard cannot be used for comparison. (BBB)

34047 GRANULOPOIESIS AFTER THERAPEUTIC IRRADIATION. EVALUATION OF DAMAGE AND RECOVERY. Sacchetti, C.; Morra, L.; Boccaccio, P.; Ponassi, A. (Queen Mary Adelaide Surgical Orthopaedic Hospital, Turin). Minerva Radiol., Fisioterap. Radiobiol., 10: 148-56(Apr. 1965). (In Italian)

Ten neoplastic subjects were selected in order to study the granulopoiesis before, at the end of, and 30 days after irradiation. Labeling in vivo with DF ^{32}P and the reserve mobilization test with bacterial endotoxins were performed each time. Full correspondence between the availability of the bone marrow reserve and the amount of the granulocytosis after Pyrexal was observed. The importance of the reserve is discussed and subsequent phases of damage and recovery are indicated. It is proved that irradiation causes depletion of the reserve and that an interval of 30 days is not sufficient to assure in all cases the recovery of a bone marrow reserve of normal size. It is stressed that peripheral counts of granulocytes alone are insufficient to evaluate granulopoiesis and practical criteria for an adequate study without the use of radioactive tracers are presented. (tr-auth)

34048 UROLOGICAL COMPLICATIONS OF TREATMENT OF CERVICAL CARCINOMA. Maurizio, E.; Malagamba, G. Roma. Minerva Urol., 16: 127(1964).

Cervical carcinoma remains the fundamental problem of gynaecology. In expectation of mass prophylaxis in the future, the gynaecologist finds himself confronted at present with the task of treating carcinoma of the cervix at the various stages in which the patient presents herself on admission. The modern treatment of cervical cancer hinges on radio-surgery with additional aid from other sources (hormonal, chemo-cytostatic therapy). An analysis of relevant admissions to the Hospital for Women in Rome during the last 10 years is presented. It shows that in the majority of cases the treatment consisted in radiotherapy or surgery preceded and/or followed by radiotherapy. Urological complications are discussed from the viewpoint of lesions caused by the development of the carcinoma in the domain of renal excretory pathways, from the viewpoint of early and late surgical lesions and radiological complications. Statistical data are presented of urological complications linked with radio-surgery of cervical carcinoma, their pathogenesis, prophylaxis, and treatment. (Excerpta Med.)

34049 BRAIN TUMOR SCANNING. ACCURACY OF RADIOMERCURY-CHLORMERODRIN. Green, J.; Nopparat, T.; Rubin, Philip (Univ. of Rochester, N. Y.). N. Y. State J. Med., 65: 403-8(Feb. 1, 1965).

The use of ^{203}Hg-chlormerodrin and its advantages over ^{131}I-labeled serum albumin (RISA) are described. Results of brain scanning with ^{203}Hg-chlormerodrin in 168 cases are reported. (TCO)

34050 THE PROBLEM OF CLINICAL INTERPRETATION OF HISTOLOGICAL FINDINGS IN CANCER CORPORIS UTERI FOLLOWING THE RADIATION. Belorosky, B.; Siracky, J. (Oncological Research Inst., Bratislava). Neoplasma, 12: 51-6(1965).

Postirradiation changes were examined in 22 cases with adenocarcinoma of the uterus in which standard Ra therapy with two applications with a total dose of 6000 mg-hr and 1800 mg-hr was delivered. Curettage at 3 to 6 months' intervals following the termination of Ra therapy was carried out. In eight cases, curettage carried out 6 months following radiation treatment gave a positive result. Repeated three times, the histological findings remained positive and therefore additional treatment (either Ra application or operation) was indicated. In five cases the histological finding showed considerable regressive changes in fragments of carcinomatous tissue or isolated carcinomatous cells; therefore, another curettage was made after three months' interval, and was in three cases positive, in two negative. In four cases, six months following the treatment the control curettage gave a negative result but repeated curettage revealed a cancer. In 10 cases the result of curettage was negative. Clinical course of the disease was also negative and asymptomatic, but in two of these cases metastasis in vagina was found in further examinations. Regressive changes in the biopsied cancer cells are illustrated, and problems in histologic diagnosis of cancer cells considered. The time when total disappearance of carcinomatous tissue with local primary healing may be expected after the termination of radiation therapy remains undetermined. Another problem is whether in the same time interval a positive curettage reflects regressive changes, i.e., the survival of harmless cells or persistence of cancer in a sense of radioresistance. Morphological characters of both of these eventualities may be almost identical. It is therefore difficult to get exact information about the biological and clinical response from the finding in the histological picture. It is often difficult to characterize precisely small fragments of tissue and to differentiate a clump of neoplastic cells from normal epithelial or mesenchymal cells with postradiation changes. These observations indicate that the six months' interval following the therapy is the most suitable for the evaluation of the result of the radiation therapy. (BBB)

34051 THYROID-REPLACEMENT THERAPY. Selby, John B. (Lexington Clinic, Mass.). New Engl. J. Med., 272: 107(Jan. 14, 1965).

The constant increase of hypothyroidism after radioiodine therapy in thyrotoxicosis is confirmed, and as a possible means of avoiding hypothyroidism the use of thyroid-replacement therapy is considered. As prophylaxis, no strong argument now exists against its use in transient hypothyroidism or for the frequently associated ophthalmopathy that may occur in the therapy of Graves's disease. Prophylactic thyroid therapy is considered since a 50% incidence of hypothyroidism has been reported ten years after ^{131}I treatment of diffuse toxic goiters. The incidence of diffuse toxic goiters is not so large that this would promote the wholesale use of thyroid therapy. The danger of delayed, unrecognized myxedema is far greater than the danger of prophylactic thyroid therapy to patients after the control of their hyperthyroidism with ^{131}I, it is suggested, and over 50% of the diffuse toxic goiters will require therapy anyway after control with ^{131}I. The cost of such therapy would represent 75 cents (U.S.P. thyroid) per month (less than the 85 cents per month with L-thyroxine). In recent years there has been indiscriminate recommendation of thyroid therapy for goiters, this including a very heterogenous group. The prophylactic use of thyroid after ^{131}I therapy in diffuse toxic goiter is comparable to its prophylactic use in Hashimoto's disease before the onset of myxedema. The previous suggestion that all patients given ^{131}I should have subsequent antithyroid-drug therapy as a safer procedure is not acceptable. Reduction of the ^{131}I dose in the treatment of hyperthyroidism and closer follow-up of the patients are recommended to reduce the incidence of hypothyroidism as a complication of radiotherapy. (BBB)

34052 VISUALIZATION OF INTERNAL ORGANS BY PHOTOSCANNING. Nelp, Wil B. (Univ. of Washington, Seattle). Northwest Med., 63: 763-6(Nov. 1964).

Consideration is given to the principles of photoscanning instruments, as well as the characteristics of the isotopes used and the physiologic mechanisms responsible for their concentration in specific tissues. Radioisotope photoscanning is the visualization of an internal organ, or in some instances tumor, by mapping out the spatial distributions of a γ-emitting isotope deposited within the organ. The two basic requirements are a radioisotope or radioisotopically labeled substance which can be selectively concentrated in the organ of interest, and a scanning instrument which can detect this radioactivity and convert it into an easily interpreted visual image. Positron or coincidence scanning, employed mainly for detection of intracranial lesions, utilizes the fact that positron-emitting isotopes such as ^{74}As emit two 0.51-Mev γ photons exactly 180° opposite in direction when the positron is annihilated. Because of this directional property, positron scanning does not require elaborate shielding or collimation of the two detectors. The camera system of imaging, still in a developmental phase, is based on the principle of the pin-hole camera. This type of imaging has expanded to include a positron adaptation and a multiple small-crystal γ fluoroscope. These systems permit rapid repetitive imaging to visualize kinetics of isotope concentration. The common method of photoscanning, linear scanning with focused collimators, offers good sensitivity and resolution at reasonable cost. The principles of this method are explained. Illustrated are a series of contrast response curves in relation to film density vs count rate, and the question of how small a lesion can be seen by scanning is discussed. This depends on the type of collimator, contrast setting, and organ under study, but in relatively thin organs near the surface of the body, such as the thyroid, lesions 1 or 2 cm in diameter may be seen easily. In deeper, thicker organs such as the liver, round lesions at a depth of 10 or 12 cm may be seen only if they are at least 3 cm in dia. Also described and illustrated is the linear photoscanning system which has been assembled at the University of Washington. (BBB)

34053 SPLENIC SCANNING. Wagner, Henry N. Jr. (Johns Hopkins Univ., Baltimore). Northwest Med., 63: 767-70(Nov. 1964).

Recent developments in the use of radioisotopes to examine the spleen are discussed, and an assessment is made of the radiation hazard and toxicity associated with their use. A table lists the mechanisms of localization that have been used in radioisotope scanning procedures. In the original technique the patient's red blood cells were labeled with ^{51}Cr and damaged by heating, leading to their sequestration by the spleen after their intravenous injection. More recently a new radiopharmaceutical, 1-mercuri-2-hydroxypropane (MHP) labeled with either ^{203}Hg or ^{197}Hg has been used. Phosphorus-32, ^{59}Fe, and ^{42}K were used as red blood cell tracers before the discovery in 1950 of the ^{51}Cr method. In the technique of splenic scanning with MHP, 0.5 to 15 ml of whole blood from the patient is added to 100 μC of ^{203}Hg- or 300 μC of ^{197}Hg-labeled MHP, together with 1 mg of stable MHP per ml of packed red cells. The blood is then reinjected into the patient and the scanning procedure routinely carried out one to two hr later. Some results obtained in successful visualization of the spleen with MHP in 200 patients are illustrated. With the ^{51}Cr method, splenic radioactivity decreases with a half-time of about one week, and the radioactivity is excreted in the urine. In contrast, radiomercury leaves the spleen between four and eight hr after injection and subsequently accumulates predominantly in the kidneys and liver. In dogs it was established that chemical doses of one mg of Hg per kg body weight are safe, and in labeled MHP, the dose of Hg should be below 0.1 mg/kg body weight, so that toxic reactions will not occur. As for the radiation hazards, the labeled red cells are promptly cleared from the blood so that the total body radiation is negligible. Nor is splenic radiation significant since the radioactivity remains in the spleen for only a few hours. The limiting organ from the standpoint of radiation is the kidney. The urinary ex-

cretion of the radioactivity is at a nearly constant rate of about 0.5% of the dose per day, and ¼ of the radioactivity appears in the stool, as a result of biliary excretion. The radiation exposure to a 150-g kidney from a dose of 100 μC of ^{203}Hg BMHP is about 70 rad. The use of ^{197}Hg is preferable, since the radiation dose will thereby be reduced to at least one-tenth. (BBB)

34054 ATTEMPTS AT VISUALIZATION OF THE PARATHYROID AND PANCREAS BY PHOTOSCANNING. Beierwaltes, William H. (Univ. of Michigan, Ann. Arbor). Northwest Med., 63: 771-6(Nov. 1964).

First attempts to solve the problem of parathyroid visualization involved the use of ^{57}Co-labeled vitamin B_{12}; although its relative tissue concentration was adequate to reveal parathyroid tissue when it was clearly separate from the thyroid area, it demonstrated too little differential concentration when a parathyroid adenoma was in the region of the thyroid. The relative concentration factor was less than two in parathyroid vs thyroid, but was four when comparing parathyroid adenoma with tissues outside the thyroid area. The principal problem, however, is that ^{57}Co-vitamin B_{12} has such low specific activity. Therefore, the use of ^{75}Se-labeled methionine was studied on the basis of a report of satisfactory visualization of parathyroid adenomata using this compound. The ^{75}Se has a physical half life of 128 days and the only emission is γ, of 0.27 Mev. A model was developed to simulate relative tissue concentrations of ^{75}Se-methionine in parathyroid and other tissues. Photoscans obtained over this model indicate that delineation of parathyroid adenomata is possible on the basis of relative tissue concentrations, and size of the expected adenomata. The radiation dose, based upon a 240-day follow-up of two patients after a 250-μC dose, was found to be about 2.0 rad whole-body dose. The blood concentration of ^{75}Se-methionine becomes minimal at 30 min and then rises fairly rapidly to a plateau at about 6 hr. In experiments in dogs it was found that the parathyroid gland concentration of ^{75}Se-methionine is considerably higher two hr after the tracer dose than at 24 or 48 hr. The two principal problems in use of ^{75}Se-methionine, the present impurity of the ^{78}Se-methionine and concentration of ^{75}Se by bone marrow, are discussed. Selenium-75 concentrates in the area of the cervical and thoracic spine, and sternum, and even the clavicles, suggesting bone marrow concentration. Data obtained on concentration of ^{75}Se in the bone marrow one-hour after administration of a tracer (100 μC) dose show a level of 3563 cpm/ml bone marrow. Using ^{75}Se-methionine, scanning in six patients later found to have a hyperfunctioning parathyroid adenoma showed an adenoma in two patients. In trying to diagnose carcinoma of the body or the tail of the pancreas or pancreatitis in a patient where this diagnosis is suspected the same ^{78}Se-labeled methionine compound was used. The calculated radiation dose is about 0.6 rad of whole body radiation, using 3 μC/kg. The cost of the labeled compound is so high that the expense of about $125 per scan is not justified in view of the present diagnostic weaknesses of this test. Although this test is imperfect at present, this study has shown that the pancreas can be visualized directly with a relatively simple and atraumatic technique. (BBB)

34055 RADIOISOTOPE TESTS OF CALCIUM ABSORPTION. Rich, Clayton; Ivanovich, Peter (Univ. of Washington, Seattle). Northwest Med., 63: 792-6(Nov. 1964).

Calcium absorption was measured by feeding calcium gluconate containing a small amount of ^{45}Ca followed by intravenous ^{47}Ca. To perform the test, fasted subjects were given a solution of calcium gluconate containing 10 to 500 mg calcium and about 5 μC ^{45}Ca. An unabsorbed substance, chromic oxide, was given at the same time so that the completeness of stool collection could be determined, and ^{47}Ca was given by vein two hr later so that its recovery in stools could be used to correct for endogenous calcium. Absorption was calculated from recovery of isotopes in the stools according to the relation: fractional absorption is the dose of ^{45}Ca minus ^{45}Ca excreted in stools plus k, where k is the endogenous fecal ^{45}Ca, and can be calculated from k^1, the fraction of the intravenous dose of ^{47}Ca excreted in feces. Results of study of some patients with different diseases are shown. To avoid collection of feces, methods are described in which either blood radioactivity or excretion of radioactivity in urine is measured after an oral dose of ^{45}Ca or ^{47}Ca. In one case the peak activity and in the other the total amount excreted within some set time is correlated to calcium absorption. The first test is dependent upon two processes, both of which operate simultaneously: the rate at which radioactivity enters the blood stream due to absorption, and the rate at which it leaves, in this case because of mixing or exchange of ^{45}Ca with stable tissue calcium. Most normal subjects have maximum blood radioactivity two hours after an oral dose, but in persons with abnormal intestinal function, peak activity may be as early as 30 min or as late as four hr. This procedure has the advantage of simplicity, and although it suffers some loss of accuracy, it is sufficiently accurate for screening for gross abnormalities of absorptive function. Another method in which the γ-emitting isotope, ^{47}Ca, is given with the oral dose and radioactivity of the forearm subsequently measured by means of a large volume liquid scintillation counter, may have some additional advantage, as an estimate of the rate of bone uptake of ^{47}Ca is derived. (BBB)

34056 DIAGNOSTIC ROLE OF RADIOACTIVE VITAMIN B_{12}. Nelp, Wil B. (Univ. of Washington, Seattle). Northwest Med., 63: 865-70(Dec. 1964).

The choice of Co radioisotopes for diagnosing clinical conditions involving vitamin B_{12} is considered, along with suggested administered doses, estimated tissue doses, and advantages and disadvantages of various isotopes and techniques. Two isotopes of cobalt, ^{60}Co and ^{57}Co, are now commonly used to label vitamin B_{12}. A table compares the physical and dosimetry characteristics of the two labels. Cobalt-60 vitamin B_{12}, the first label available, is satisfactory and safe for most studies. Its physical half-life is longer, however, than that of ^{57}Co and its emission increases the radiation exposure following absorption. On the other hand, the shorter half-life of ^{57}Co, its lack of β decay, coupled with the lower γ-ray energy, results in much less radiation delivered to the liver per μC absorbed (0.3 vs 8 rad). In addition, ^{57}Co can be obtained with a much greater sp act. (μC per μg) and due to its low γ-ray energy it can be counted with more efficiency. Because of this, it is only with ^{57}Co-vitamin B_{12} that it is feasible to count the small amounts of radioactivity which appear in plasma following oral doses of the vitamin. Results of measurement of the percentage of the oral dose absorbed (by measuring fecal radioactivity), following the administration of increasing amounts of vitamin to normal subjects, are outlined. When the administered dose ranges from 0.1 to 0.5 μg, about 70% is absorbed. However, with larger doses, progressively smaller percentages are absorbed although slightly larger quantities are absorbed. Since in most diagnostic tests measurements relating to the percentage of the absorbed dose are dealt with, it is important to adjust the micrograms of vitamin B_{12} in the administered dose. Tests of absorption are satisfactorily performed by administering 0.5 μg of vitamin B_{12} containing about one μC of radioactivity. Various test situations which have been devised in an effort to quantitate B_{12} absorption are described. The most direct method is collecting and measuring stool radioactivity following an oral dose of labeled vitamin. An indirect method is to place a surface detector externally over the liver and measure the rate of accumulation of radioactivity appearing in the liver following an oral dose of radiocobalt-labeled vitamin. This is very indirect and gives little quantitative information. Indirect measurement of the urinary excretion of the labeled vitamin following a saturating dose of stable vitamin (the Schilling test) is a useful and fairly simple method to characterize normal and abnormal states of vitamin B_{12} absorption. Another indirect method to measure B_{12}, namely measuring the amount of ^{57}Co-vitamin B_{12} radioactivity absorbed in the plasma eight hr following administration of the dose, is mentioned. This method is simple and has other major advantages. Results of measuring a single

plasma sample eight hr following a dose of one μC of ^{57}Co-vitamin B_{12} containing an average of 0.3 μg of stable vitamin are illustrated. Another diagnostic use of radioactive vitamin B_{12} is described, namely, for measuring the glomerular filtration rate. (BBB)

34057 TREATMENT OF HYPERTHYROIDISM AND THYROID CANCER WITH ^{131}I. Beierwaltes, William H. (Univ. of Michigan, Ann Arbor). Northwest Med., 63: 871-7(Dec. 1964).

Preliminary data are provided on a survey of 1000 radioiodine-treated patients for possible serious side-effects, and a literature survey covering about 50,000 subjects is also included. Such world-wide experience with this large number of patients treated for hyperthyroidism with ^{131}I reveals no evidence of increased incidence of leukemia, thyroid cancer, or fetal abnormalities. As a result of these negative studies on the possible harmful effects of ^{131}I for the treatment of hyperthyroidism in persons under age 40, most clinics are now treating patients with ^{131}I for Graves' disease down to age 20 and some are treating patients down to age 15 as a matter of routine. The author advises decreasing the minimum age five yr, every two yr, with the plan of eventually treating patients down to age 20 as a matter of routine. The use of ^{131}I for the treatment of toxic nodular goiter should not be the first choice. The use of antithyroid drugs plus Lugol's solution is preferred to get the patient euthyroid. Subtotal thyroidectomy is then performed. When surgery is not indicated, for any reason, ^{131}I may be used successfully to treat hyperthyroidism. If the goiter disappears during treatment, a subtotal thyroidectomy is no longer necessary. A quantitative formula for the calculation of the treatment dose of ^{131}I for hyperthyroidism, assuming an effective half-life of six days, is outlined, and a table for rapid estimation of the required dose is also given. This table is based on the assumption, derived from experience, that the average size single treatment dose necessary to relieve a patient of hyperthyroidism is about 10 mC. This dose is then varied by ±1 or 2 mC dependent upon the following factors: (1) weight of the gland, (2) per cent uptake at 24 hr, and (3) transit time of ^{131}I in the thyroid. Generally, the transit time of ^{131}I through the thyroid gland is dependent upon the storage space. After comparing the patient to the average case of Graves' disease and making the appropriate adjustment of 1 or 2 mC in the dose, that is, if the weight of the thyroid gland is 10 or 15 g greater than average, an increased dose will have to be given to our patient to produce an equivalent amount of radiation per g of tissue. Similarly, if the ^{131}I per cent uptake is 10 or 15%, or more, higher than average, the dosage may be decreased by 1 or 2 mC and still effect the same concentration per g of tissue. If the transit time is shorter than usual, a larger dose must be given to deliver the same radiation provided by a smaller dose staying in the thyroid for a longer period of time. Reasons are given for not using much smaller doses and repeating them if necessary in order to avoid the complication of hypothyroidism. In the author's survey the incidence of hypothyroidism as judged by a subnormal serum protein-bound I (PBI) during the first year after subtotal thyroidectomy was identical to the results years after ^{131}I treatment, namely 55%. Use of ^{131}I and dose estimation in treatment of thyroid cancer are also outlined, with significant details of a follow-up of 200 patients treated for thyroid cancer with radioiodine. The average treatment dose of ^{131}I for concentration within the neck and within the thyroid gland is initially 165 mC. Outside the gland but in the neck the dose is 185 mC; 200 mC is used routinely as the average treatment dose for metastases outside the neck. Doses go no higher than 200 mC since there is no evidence that doses larger than 200 mC accomplish any more than the dose of 200 mC. (BBB)

34058 ISOTOPIC STUDIES OF BODY WATER AND SODIUM IN HYPERTENSION. Blumberg, Alfred (Univ. of Washington, Seattle). Northwest Med., 63: 878-80 (Dec. 1964).

The use of ^{22}Na, ^{82}Br, and $^{35}SO_4$ for measuring body water is dealt with. Measurements of body water compartments and body sodium have been greatly advanced and facilitated by the introduction of radioisotopes. Though these methods are not routine clinical tests, they are simple to perform, and contribute substantially to the understanding of pathophysiological processes. Some aspects of extracellular volume (ECV) and exchangeable sodium (Na_e) in relation to hypertension are discussed. For such a method to be valid, it is important that the test substance equilibrate evenly with and stay completely within the measured compartment. For Na_e the situation is ideal since radiosodium, ^{22}Na or ^{24}Na, will mix completely and exclusively with the exchangeable pool of body sodium. Tritiated water also mixes completely with body water and, therefore, may be used in measuring the total volume. However, measurement of ECV is less accurate because no ideal has been found that diffuses into all parts of ECV but at the same time stays completely out of cells. Some substances give reasonable approximations when used to measure ECV, and can be divided into two groups: the saccharides (inulin, sucrose, mannitol), and the ions ($^{35}SO_4$, thiosulfate, thiocyanate, radioactive and nonradioactive bromine). In the described studies, Na_e and ECV were measured simultaneously using ^{82}Br (for ECV) and ^{24}Na (for Na_e). These γ-emitting isotopes with a short half life provide ease of detection, great precision in counting, and low radiation exposure to the patient. After intravenous administration of the isotopes, 24 hr is allowed for distribution during which time urine is collected in order to correct for excretion losses. Radioactivity is measured in plasma samples after separation of Na and Br with an anion exchange resin. The volume of distribution of ^{82}Br is then calculated by dividing the amount of radioactivity remaining in the body at 24 hr, by the concentration of radioactivity in plasma water. On the average, 93% of plasma volume is water. In the case of Na_e the volume in ml is multiplied by the plasma Na concentration in meq per ml to obtain Na_e. Some results obtained in patients and their clinical interpretation are discussed. These findings show that in many patients with renal disease, hypertension is concomitant with an increase in ECV and Na_e and that it can often be controlled by Na restriction or by salt and water removal by dialysis without lowering body Na and ECV below normal. (BBB)

34059 BLOOD VOLUME MEASUREMENTS AND CELL SURVIVAL DETERMINATIONS. Hillman, Robert (Columbia-Presbyterian Medical Center, New York). Northwest Med., 63: 896-900(Dec. 1964).

The measurement of red cell volume by using cells tagged with ^{51}Cr and plasma volume through use of radioiodinated human serum albumin (RISA) is considered. Many isotopes can be used to measure blood volume. Although ^{51}Cr and ^{32}P are commonly mentioned for use in labeling the red blood cell, ^{51}Cr is by far preferable. It is easily and efficiently tagged to the red cell, does not elute significantly during the short period of study and, compared to ^{32}P, is far easier to count. Red cells properly labeled with ^{51}Cr do not appear to be damaged by the minute amounts of Cr used, and circulate normally with a uniform distribution in the red cell mass. The ^{51}Cr method when checked against the older methods yields identical results. Actually the ^{51}Cr tagged red cell cannot directly measure the total blood volume per se. Blood is a two phase system, particulate red and white blood cells, and plasma, each of which must be measured separately so that the sum of the two will represent the total blood volume. The white blood cells and platelets make up a minute portion of the total volume. Available for plasma volume measurement are several equally accurate isotopic and nonisotopic tags. Of the isotopes, both ^{59}Fe tagged to transferrin and ^{131}I RISA have been used with the latter being by far the more popular. Of the nonisotopes, the albumin binding dye T 1824, or Evan's blue, offers comparable detection means. RISA plasma volumes can be done with very small amounts of radioactivity, 5 to 10 μC per volume, permitting serial plasma volumes in a single patient. Because it can also be purchased in small amounts it is the most commonly used material. Iron-59, because of its utilization in red cell production, and the dye because of its tendency to stain the skin when multiple injections are given, do not

lend themselves as readily to repeated determination. Thus ^{51}Cr for red cell volume and RISA for plasma volume are the preferable isotopes in routine work. The technical aspects of isotopic estimation of blood volume are described. (BBB)

34060 CARCINOMA OF CORPUS AND ENDOCERVIX. Thompson, Nicholas J.; Graham, John B. (Roswell Park Memorial Inst., Buffalo). Obstet. Gynecol., 24: 144-6(July 1964).

Comparative data is presented on the treatment of 52 patients with x rays plus Ra or Ra alone. Group I patients were treated with 5700 R full-pelvis x-ray therapy over a 5-week period, followed immediately by Ra, 3000 mg-hr to Point A. Group II patients were treated primarily by Ra. Multiple capsules in the uterine cavity, cervical plaques, and vaginal cylinders were used. Total dosage ranged from 6500 to 8800 mg-hr. Some of these patients also received 1000- to 3000-R full-pelvis x-ray therapy. The results were poor where the tumor extended beyond the uterus, and the type of treatment did not seem to influence the course of the disease. However, when the tumor was apparently confined to the uterus, the method of treatment did seem to influence the results. The large dose of full-pelvis x rays (5700 R) followed by Ra (3000 mg-hr) was inferior to the primary Ra with or without supplemental x-ray therapy. Good results were obtained with total hysterectomy. The results suggest that carcinoma of the corpus and endocervix should be treated like cancer of the uterine body rather than of the cervix. The large dose of x ray followed by Ra is effective in advanced cervical cancer, but in this series it was too intensive and a supralethal effect resulted. It is recommended that a moderate dose of Ra be given in two sittings three weeks apart, with multiple tubes in the uterine canal. A plaque should be placed against the cervix at one session, and a cylinder (3 cm in dia) covering the entire length of the vagina at the other session. The total dose is about 7000 mg-hr. Supplemental x-ray therapy should be given to the lateral pelvis if there is clinical evidence of extension. (BBB)

34061 THYROID UPTAKE AND BODY BACKGROUND. Kutka, M.; Porr, J.; Semprebene, L. (Universita, Rome). Panminerva Med. [(English Ed.)], 6: 438-40(1964).

Radioalbumin and radioiodine together with Lugol's solution, $KClO_4$ or Tapazole premedication were used to study the components of thyroid region radioactivity in human subjects. In measuring thyroid uptake, radioactivity from intra- and extra-thyroid vessels and trapped radioactivity contribute to body background of the neck. The neck-thigh radioactivity ratio after radioalbumin administration was greater than unity. The methods commonly used for eliminating the effects of body background of the neck (thyroid shielding, subtraction of thigh radioactivity, or of vessel radioactivity in the thyroid region), were shown to be inadequate. (Excerpta Med.)

34062 DETECTION OF INTRACRANIAL LESIONS BY CONTOUR BRAIN SCANNING WITH RADIOISOTOPES. Feindel, William (McGill Univ., Montreal). Postgrad. Med., 31: 15-23(Jan. 1962).

In this review, automatic contour brain scanning is compared with manual and rectilinear scanning methods. The contour scan chart corresponds closely to anatomic features, and the method allows the radiation detectors to see a relatively uniform volume of tissue with a more constant ratio of skull and scalp tissue to brain tissue. Foreshortening and distortion of the curved surfaces of the head are reduced to a minimum. The method is not restricted to any particular isotope. Radioiodinated human serum albumin (RISA) is especially suitable for brain scanning because it exploits the normal selective permeability of the blood-brain barrier and also gives an indication of lesions with increased vascularity. Thus RISA emits γ radiation suitable for external detection, is relatively inexpensive and readily obtained, and has a convenient half-life of eight days. Furthermore, albumin does not permeate normal brain tissue to a significant degree and is less likely to leak out of the circulating blood into extravascular tissue. Highly vascular lesions, such as angiomas or meningiomas, show up almost immediately after RISA is introduced into the blood stream, whereas when increased permeability of albumin is a more significant factor, as in less vascular gliomas or chronic subdural hematomas, a more gradual buildup of RISA concentration may take place. Contour scans of 115 neurosurgical patients with verified intracranial lesions correlated well with clinical findings in about 90% of the cases. The patient is prepared for scanning by blocking the thyroid gland with iodine, administered by mouth as Lugol's solution 24 hr before injecting 300 to 400 μC of RISA intravenously. The patient is positioned and the scan is then automatically carried out over a period of 30 min. The continuous background of radioactivity over the head is indicated by parallel rows of dots stamped on the chart and corresponding to the arcs traversed by the detectors over the head. Each dot can represent 100 to 400 counts, depending on the level of counting desired. Use of more selective radioactive indicators and improved instrumentation can be expected to make brain scanning increasingly valuable in diagnosing intracranial lesions and in research in this field. However, brain scanning, at its present stage of development, should be regarded as a supplementary diagnostic technic which gives considerable information on the permeability and vascularity of intracranial lesions, but it is not a substitute either for a careful neurologic examination or pneumoencephalography and angiography. (BBB)

34063 NEW TECHNICS IN NEUROSURGERY. Mullan, Sean (Univ. of Chicago Hospitals, Ill.). Postgrad. Med., 37: 636-41(June 1965).

Three new neurosurgical technics are presented: percutaneous ^{90}Sr cordotomy, percutaneous electric cordotomy for intractable pain, and copper electric thrombosis of intracranial aneurysms. In each case, a simple needle placement brings about results previously accomplished by open operative procedures. (TCO)

34064 LATE LESIONS OF THE LARYNX AFTER RADIUM IRRADIATION OF VOCAL CORD CARCINOMA. Minnigerode, B. (Universitats Hals-Nasen-Ohrenklinik, Gottingen, Ger.). Pract. Oto-Rhino-Laryngol., 26: 409-17 (1964). (In German)

Regardless of the Ra irradiation dose used, the incidence of late radiation lesions of the larynx was 19.8% of 293 cases of vocal cord carcinoma treated over the period from 1945 to 1963. The Ra dosages ranged up to 1550 mg-hr. The lesions observed included 32 cases of fibrinotic chorditis, 13 of fibrino-ulcerotic chorditis, 7 of persistent longitudinal fistula in the region of the surgical scar, and 6 of radioinduced cartilaginous dystrophy. The appearance of the late lesions was unrelated to the degree of spread of the carcinoma, the stage of the tumor, or to the irradiation procedure used. The times of appearance of the lesions also were unrelated to the interval between irradiation and first appearance. The causes for the appearance of the lesions may have included infection, mechanical irritation, or occupationally related chemical effects, or possibly a combination of these. The treatment of these lesions includes avoidance of infection or noxious agents such as smoke, and treatment to reduce inflammatory processes. (BBB)

34065 1964 RUTHERFORD MEMORIAL LECTURE. π MESONS VERSUS CANCER. Fowler, P. H. (Wills Physics Lab., Bristol, Eng.). Proc. Phys. Soc. (London), 85: 1051-66(June 1965).

The case is made for the investigation of various beams of heavily ionizing radiations with a view to their eventual use in radiotherapy. Beams of heavy ions and stopping mesons (π^-) are considered, and the probable oxygen enhancement ratio and distribution of dose with depth are compared with ^{60}Co γ rays and other beams in current use. Beams of stopping mesons (π^-) give an excellent distribution of dose with depth, and a very favorable oxygen enhancement ratio. The feasibility of preliminary experiments with biological material is considered. (auth)

34066 IN VIVO RADIATION DOSIMETRY FOR CLINICAL AND EXPERIMENTAL RADIATION THERAPY. Roswit, Bernard; Malsky, Stanley J.; Amato, Charles G. (Vet-

erans Administration Hospital, Bronx, N. Y.). Progr. Clin. Cancer, 1: 96-126(1965).

An extensive account of the development, characteristics, and applications of solid-state, in vivo dosimeters is given. A systematic and critical survey was made of existing dosimeters, employing certain criteria generally regarded as essential and desirable for any proposed in vivo dosimetry system (detectors, applicators, reader, and instrumentation). Examination of ionization chambers, Geiger counters, scintillation crystals, chemical dosimeters, photographic emulsions, and solid state detectors showed that none, with the exception of the solid state materials, satisfied most of these criteria. Their outstanding limitation was excessive size, but other faults included marked energy dependence, unsatisfactory dose range, costliness, poor read-out technology, sterilization prcblems, and unavailability. The solid state materials, however, appeared to provide the best source for development of successful in vivo dosimetry systems, and two solid state systems, both based on the production of luminescence, were used as a basis for the in vivo dosimetry developed. The development of a miniature radiophotoluminescent (RPL) glass rod dosimeter (measuring 1 by 6 mm) is discussed. This dosimeter, with appropriate shielding and screening, can be employed effectively in clinical and investigative studies where accurate in vivo measurements are essential. Also described are RPL dosimeters, made in the form of a cylinder: 1 mm in outside dia and 6 mm in length. Spheres 5 mm in dia have also been made. These glass dosimeters are comprised of a matrix and an added impurity or dope: silver metaphosphate—the radiation sensitive element. When x or γ rays are absorbed by the glass, disassociation takes place and photochemical reactions follow. There is a net formation of atomic silver of zero valence, which in the proper electronic environment as provided by the host absorb uv light and re-emits it as orange-yellow light, the intensity of which is directly proportional to the amount of radiation absorbed. This is the basis for this relative dosimetry system, ionizing radiation exciting the radiation-sensitive glass. The orange-yellow fluorescence is detected, using a yellow bypass filter and a suitable photomultiplier tube: the output current of the tube is amplified and a read-out system is employed using a dc microammeter. The characteristics of some glasses are listed in a table, and are extensively discussed. These dosimeters cost less than $.50 each. The glass is fabricated as long rods having the desired diameter, and these rods are cut into small cylinders, 6 mm high. The use of regular composition glass to measure the γ exposure delivered by a mixed radiation field containing both γ rays and neutrons is also considered. Clinical applications of the in vivo system of dosimetry in radiation therapy, using screened, predosed, gold-shielded glass rods which are energy independent in the whole therapy range from 250 to 2000 kev, including radium, radon, iridium-192, cobalt-60 and cesium-137, are considered. Its accuracy was good (±7%), and it was dependable in all tissue volumes, even for total-body radiation. Precise radiographic localization within the body is possible because of the opaque gold shield. With the dosimeter so miniaturized it is possible to place it with safety and ease in nearly every body tissue organ and space in the living patient. Although RPL dosimetry has solved many clinical problems in radiotherapy, it has certain limitations. Its range is restricted to from 10 to 15,000 R; and its energy response in the very low-energy region (as in diagnostic radiology) is unsatisfactory, even when low Z glass is used. A complementary dosimetry system based on the principle of radiothermoluminescence (RTL) may overcome these deficiencies. The estimated range for RTL dosimeters is slightly less than 1 mR to almost 250,000 R. (BBB)

34067 DETECTION OF OCCULT METASTASES TO BONE BY PHOTOSCANNING WITH RADIOISOTOPES OF STRONTIUM. Charkes, N. David; Sklaroff, David M. (Albert Einstein Medical Center, Philadelphia). Progr. Clin. Cancer, 1: 235-57(1965).

The use of ^{45}Ca, ^{47}Ca, ^{85}Sr, ^{87m}Sr, and ^{89}Sr for the detection of lesions in bone are reviewed, with reference to 66 publications, and the authors' techniques and results in patients with bone metastases are described. Although ^{47}Ca studies were formerly conducted in man, a high-specific activity radioisotope of strontium, ^{85}Sr, has become available for human use and has proved to be of considerable clinical interest. The 0.513-Mev γ photon of ^{85}Sr is readily collimated by existing commercial lead-focusing detectors, whereas the high-energy ^{47}Ca photon (1.31 Mev) penetrates the lead septae so readily that localization of the γ-ray source by conventional scanning equipment is not feasible. In short-term studies, the accretion rates of ^{47}Ca and ^{85}Sr resulting from exchange processes are similar if not identical, and rapid uptake by bone is readily demonstrated. Strontium-85 decays by electron capture to metastable ^{85m}Rb which in turn decays to stable ^{85}Rb by emission of a γ photon of 0.513 Mev; ^{85}Sr has a physical half-life of 64 days. It is prepared by the (n,γ) reaction on an enriched ^{84}Sr target in the nuclear reactor, or by proton or deuteron bombardment of ^{85}Rb in the cyclotron. Strontium-85, with a high sp act. and with a purity of more than 98% is currently available. Less than 1 μC of ^{89}Sr contaminates each 100 μC of ^{85}Sr injected. Initially, 50 μC was administered intravenously, but because of low count rates 100 μC is now given to adults and 20 μC to children. The mean radiation dose to bone is 1.6 to 4.6 rad/100 μC administered, although the hot spots in growing bone may absorb ten times the diffuse β dose. Because of rapid uptake by bone, satisfactory scans may be performed within an hour of intravenous injection. However, the target-nontarget ratio is improved by waiting 24 to 48 hr or more to allow urinary and fecal excretion of the radiostrontium which has not exchanged with bone. Up to 70% of the dose may be excreted within 7 days. The normal distribution of ^{85}Sr is described and illustrated. Despite satisfactory results, scanning with ^{85}Sr has several disadvantages: (1) Because of its long physical half life (64 days) and its slow turnover rate in bone (biologic half life of ~800 days), frequent repetition of the scan in order to evaluate response to therapy is not feasible. (2) As a consequence of the long effective half-life, the estimated radiation dose to bone of 1.6 to 7.6 rad/100 μC injected dose has limited the injected dose to 100 μC or less. This results in suboptimal resolution and long scanning times due to poor counting statistics. To extend these studies by use of a Sr isotope of short half-life and no particulate emission so that relatively high doses could be safely administered at frequent intervals, thereby improving resolution and shortening the scanning time, ^{87m}Sr was introduced. It decays by emission of a single γ photon of 0.388 Mev to stable ^{87}Sr and has a half-life of 2.8 hr. It is obtained by milking an ^{87}Y "cow." The radiation dose to whole body and bone is less than 1% of an equal amount of ^{85}Sr. The main disadvantages to the use of ^{87m}Sr are: (1) the high body background, since the scan must be performed before appreciable excretion is completed; (2) inconvenience of the milking, sterilization, and standardization procedure; and (3) relatively high cost of the generator in comparison with ^{85}Sr; ^{87m}Sr should prove of value in evaluating the osteogenic response to therapy of metastatic carcinoma. Results obtained in patients with these isotopes are described and the following conclusions drawn. Metastases can be demonstrated prior to roentgenographic changes, particularly in the vertebral column and pelvis. The extent of the disease is better demonstrated on the scan than on roentgenogram. Regions difficult to evaluate on roentgenogram (sternum, anterior ribs, scapula) are easily examined by means of photoscanning and often are the site of metastasis. Differentiation between traumatic and pathologic fracture can be made by demonstrating other, silent areas of bone metastasis on scan. Radiation therapy portals can be set up more accurately by use of the radiostrontium scan. Radiostrontium bone scanning has thus been found to be both a valuable diagnostic procedure and a powerful investigative tool in clinical cancer. (BBB)

34068 PROBLEMS OF THE AUTOMATIC MEASUREMENT OF DISTRIBUTION OF RADIOACTIVE MATERIALS

AND TEST RESULTS. Hegewald, Herbert (Humboldt Universitat, Berlin). Radiobiol. Radiotherap., 4: 539-48 (1963). (In German)

Characteristics of a collimator used for scintillation scanning are presented and discussed. The collimator construction, resolution, diffraction characteristics, relative sensitivity, and relative geometric count rate factor are described. Effects of diaphragm aperture and image characteristics for point radiation sources are plotted. If the sensitivity of the system is inadequate, ghost pictures may be formed when large, discrete sources of radioisotope are scanned. Increasing the specific activity of the source will not improve the image of the source which is obtained under these conditions. The performance of the collimator described is compared with other collimator types. (BBB)

34069 PREOPERATIVE IRRADIATION. Bloedorn, F. G.; Wizenberg, M. J. (Univ. of Maryland Hospital, Baltimore). Radiol. Clin., 33: 287-99(1964).

The indications and basic principles in the use of preoperative irradiation are examined with reference to knowledge of radiobiology and data empirically derived through clinical experience. The possible advantages of preoperative irradiation, both theoretical and practical, are discussed. The different modalities of irradiation, doses and treatment schedules used in preoperative irradiation throughout the world are stated and the possible advantages and disadvantages of each discussed. The main principles upon which preoperative irradiation is founded are: (1) the periphery of the tumor is more sensitive than its core. (2) For the same histologic group the sensitivity of a tumor to radiation is in inverse ratio to its volume (or number of cells). (3) The integrity and good health of the tumor bed are of great importance in obtaining a satisfactory radiation response in terms of tumor control. (4) There is much evidence that in some groups of malignant tumors the lymph node metastases can be controlled by irradiation. (5) Irradiation can change the natural history of some malignant tumors in the irradiated volume. (6) With the use of supervoltage it is possible to have surgery after a radical dose of irradiation with a lower incidence of complications. (7) Importance of the waiting period and the healing process in irradiated tissues are emphasized. With preoperative irradiation the surgical intervention should be performed when the acute reaction produced by irradiation has subsided, before the late changes of marked endoarteritis and fibrosis have set in and after a maximum regress of the tumor has been produced. This ideal period is between four and eight weeks, probably about six weeks for most cases. The main advantages to be attained by the systemic use of preoperative irradiation are: (1) Render inoperable tumors operable. (2) Control of lymph node metastases inaccessible to surgery. (3) Reduction of local and systemic seeding during surgical manipulation. (4) By reducing the peripheral lymphatic vessel and node extensions of a tumor, preoperative irradiation allows for more conservative surgery. The main objection to preoperative irradiation is the delay in healing which is always present in heavily irradiated tissues. The use of supervoltage radiation has improved this situation but impaired healing still remains the main drawback of the procedure. The optimal procedure consists of a radical dose (4000 to 8000 rad) of radiation delivered in a period of 5 to 6 weeks with surgical excision performed 6 to 8 weeks after the last radiation treatment. Complications due to the interference produced in the process of normal tissue healing can be reduced to tolerable levels, so as not to overcome the benefits of the procedure. (BBB)

34070 CHANGING CONCEPTS IN CHIAROSCURO. Warren, Clark R. (Wayne State Univ., Detroit). Radiol. Technol., 36: 218-28(Jan. 1965).

Recent developments as well as historical developments, in the improvement of the diagnostic radiographic image are reviewed, with a discussion of factors which have reduced patient exposure to x rays. Problems which have developed as a result of a new demands of limitation of exposure on radiographic image quality are considered. The report on "The Biological Effects of Atomic Radiation" before the National Academy of Sciences in 1956 created public concern for ionizing radiation exposure, and radiology staffs began to institute practical changes that would minimize the radiation received by patients during examination. Added filtration was increased to give a total of 2.5 mm Al. Techniques were instituted with higher voltage levels and lower ma-sec values. Higher speed intensifying screens and high speed films were considered. Closer coning and collimation of the primary beam was instituted. There was re-evaluation of the routine position, particularly with regard to the very young, those of procreative age, and the pregnant mothers. Radiation safety became important. Of these changes, some affected the quality of the radiographic image and lengthened still further the lengthening scale of contrast. Increased filtration, decreasing the average wavelength of radiation, lowered the contrast, particularly on exposures in the lower kilovoltage range. Higher kilovoltages designed to minimize radiation dose to the patient resulted in decreased differential of tissue absorption and lengthened the scale of contrast. The trend in exposure continued to be toward the long-scale image, with a decrease in the radiograph, and a narrowing of the separation of cones. As the diagnostic kilovolt range increased, the problems posed by the accompanying secondary radiation became a challenge to technicians and to engineers. The development of multi-line, high-ratio stationary grids has progressed to the point where they are already serving as optional replacements for moving grids. Such stationary grids, many with so many lines per inch that they are virtually invisible, permit free choice of exposure times as short as milliseconds and may well open the way for condenser discharge or field emission units to serve in place of conventional radiographic generators. Such equipment, now in production, can be charged to 1,500,000 ma at 600 kvp, with a discharge or exposure time of about $\frac{1}{10}$ of one millionth of a sec, and are adequate for radiography of the chest. The general diagnostic quality of radiographs has increased despite the obstacles posed by the changed conditions of operation. This has come simultaneously with the availability of more adequate and precise equipment and accessories, and with the removal of the human element from the development of the latent image. It also has come as a result of the changed concept of the theory of radiographic exposure, and the replacement of variable kilovoltage techniques by fixed kilovoltage-variable milliampereseconds exposures. (BBB)

34071 THYROID FUNCTION STUDY WITH ^{131}I AFTER RADICAL IRRADIATION OF THE NECK. Leborgne, F.; Leborgne, J. H.; Barlocci, L. A.; Leborgne, J. M. (Hospital Pereira Rossell, Montevideo, Uruguay). Radiologia (Panama), 15: 53-5(Mar. 1965). (In Spanish)

In 13 patients who had received radiotherapy in the neck region, thyroid function was evaluated by measurement of ^{131}I uptake of the gland. The total radiation doses varied between 4320 and 6690 R, and had been administered one month or 20 yr previously. (The nature of the radiation is not mentioned.) The thyroid function test was conducted by administering 25 μC of ^{131}I and measuring gland uptake four and 24 hr later. Protein-bound ^{131}I (PBI) was determined at 72 hr, and scintigrams were obtained in all cases. Seven patients showed normal uptake and scintigrams. In two cases the I uptake indicated a hyperfunctional gland; in one of these cases the scintigram revealed a hot nodule. Three cases showed a hypofunctional gland; two of these cases had received 9 and 14 yr previously doses of 6150 and 6200 R. The third case of hypothyroidism had received two previous courses of radiotherapy: 5900 R one month and 4850 R 20 earlier. Gammascintigraphy showed abnormalities in two patients only. The results indicated that high-dosage radiotherapy exposing the thyroid usually does not alter function of the gland. The role of irradiation on thyroid functional disorders (which were not clinically evident) could not be definitely established in the other cases. (BBB)

34072 TECHNETIUM 99m AS A SCANNING AGENT. Harper, P. V.; Lathrop, K. A.; Jiminez, F.; Fink, R.;

Gottschalk, A. (Argonne Cancer Research Hospital, Chicago). Radiology, 85: 101-9(July 1965).

The physical characteristics of technetium 99m are evaluated from the standpoint of its use as a clinical tracer material, and chemical behavior is considered from a pharmacological point of view. With ^{99m}Tc prepared as an insoluble radiocolloid, liver, spleen, and bone marrow scans may be performed with small radiation doses. As pertechnate, ^{99m}Tc is used for brain and thyroid scanning. The only serious drawback to its clinical application appears to be the necessity for chemical manipulation by the user. Commercial availability at reasonable costs seems likely in the near future. (H.G.D.)

34073 SCINTISCANNING WITH LOW-ENERGY PHOTON EMITTERS. Webber, Milo M. (Univ. of California, Los Angeles). Radiology, 85: 116-20(July 1965).

Advantages of using low-energy photon emitters for scintiscanning such as ^{125}I for thyroid scans, ^{125}I albumin for liver scans, and ^{197}Hg or ^{99m}Tc for brain scans are considered. Disadvantages are also weighed, as are advantages of using ^{131}I or ^{203}Hg for such scanning. (H.G.D.)

34074 LINEAR ACCELERATOR SUPERVOLTAGE RADIOTHERAPY. VII. CARCINOMA OF THE PROSTATE. Bagshaw, Malcolm A.; Kaplan, Henry S.; Sagerman, Robert H. (Stanford Univ., Palo Alto, Calif.). Radiology, 85: 121-9(July 1965).

In this group of 73 patients with carcinoma of the prostate treated radically by external radiation therapy, striking alleviation of local symptoms occurred in all but nine. Thirteen of 30 patients survived for more than five years without evidence of local recurrence or distant metastases. The five year survival for the entire group computed by the actuarial method was 54 per cent. It is suggested that a new approach to the treatment of localized carcinoma of the prostate is demonstrated in which survival rates comparable to those from radical surgery are achieved with less hazard to the patient. (H.G.D.)

34075 THE EFFECTS OF RADIATION THERAPY ON PULMONARY FUNCTION IN CARCINOMA OF THE LUNG. Brady, Luther W.; Germon, Patricia A.; Cander, Leon (Hahnemann Medical Coll., Philadelphia). Radiology, 85: 130-4(July 1965).

A systematic survey of physiologic changes in lung function in patients subjected to radiation therapy for treatment of carcinoma of the lung was presented. The single most significant finding was the effect of the irradiation on breath-holding pulmonary diffusing capacity and its high statistical relationship to the volume dosage delivered to the thorax. The results at one month suggest that any acute deleterious effects of radiation therapy on lung physiology are not sufficiently severe to preclude the use of this treatment even in patients with severely compromised pulmonary function. (auth)

34076 COMPUTER ESTIMATION OF DOSAGE OF INTERSTITIAL AND INTRACAVITARY IMPLANTS. Powers, W. E.; Bogardus, C. R. Jr.; White, William; Gallagher, Tom (Washington, Univ., St. Louis). Radiology, 85: 135-42(July 1965).

A method for computer estimation of interstitial or intracavitary dosage determination is described. To test the accuracy and validity of the method, the calculations are compared with published dose tables and direct measurement of dose around sources. The usefulness of this program in clinical implants and its benefits in teaching are presented. (auth)

34077 DEPTH-DOSE TABLES FOR 6 Mv X RAYS FOR USE WITH A CONSTANT SOURCE-LESION DISTANCE. Haymond, Herman R.; Ashikawa, James K. (Univ. of Southern California, Los Angeles; Loma Linda Univ., Los Angeles; and Los Angeles County General Hospital). Radiology, 85: 143-6(July 1965).

Central axis depth-dose tables for 6 Mv (h.v.l. 18 mm Cu) x rays from a linear accelerator were prepared for use with a constant source-lesion distance of 100 cm. The data were derived from published values for 6 Mv x rays at SSD 100 cm, interpolated values from published 4 Mv and 8 Mv x-ray data, and experimental determinations. A separate table for each lesion depth, at 1 cm intervals up to 20 cm, shows the depth doses, for each of seven port sizes, normalized to the depth of the lesion. For machines controlled by an integrating dosimeter which has been calibrated with a 10 × 10 cm port at 100 cm SSD, tables are presented that give: meter settings for 100 rads at the lesion for each port size and lesion depth with a constant source lesion distance; the same information with a constant source-skin distance of 100 cm; and the maximum dose for 100 rads to the lesion with a constant source-lesion distance. (auth)

34078 REVISED AVERAGE GEOMETRIC FACTORS FOR CYLINDERS IN ISOTOPE DOSAGE. PART I. Focht, Elizabeth F. (New York Hospital-Cornell Medical Center, New York); Quimby, Edith H.; Gershowitz, Martin. Radiology, 85: 151-2(July 1965).

In the formula for calculation of radiation dose from a radioisotope deposited internally, a factor g appears. This is designated as the geometrical factor, and for any point of reference represents the integration of $e^{-\mu r}/r^2$ over the pertinent volume. Here r is the variable distance from all points in the volume to the point in question, and μ is the appropriate absorption coefficient. This factor is evaluated for the center of a sphere, up to a radius of 10 cm, and for the midpoint of the axis of cylinders. The results for the average g, that is $\bar{g}$, for cylinders, using an effective absorption coefficient of $\mu = 0.028$, are tabulated. (P.C.H.)

34079 CONTROL OF PARATHYROID GLAND FUNCTION FOLLOWING ANTITHYROID THERAPY WITH RADIOACTIVE IODINE. Serio, M.; Salani, G. (Universita, Florence, Italy). Rass. Neurol. Veget., 18: 24-9(Feb. 29, 1964). (In Italian)

The possible effect of ^{131}I on the parathyroid glands when it is used to depress thyroid activity was evaluated. Since the parathyroid glands are in close proximity to the thyroid, it would be expected that they would be exposed to the γ radiation from ^{131}I in the thyroid gland. This survey was made on 73 patients which had received ^{131}I doses of 10 mC or more for hyperthyroidism. The highest dose administered was 39 mC, but most were between 10 and 20 mC. Six months after this therapy, its possible effect on parathyroid function was sought by correlating the ^{131}I administered dose with total serum Ca levels. Parathyroid insufficiency, as reflected by lowered serum Ca levels, would be expected, particularly at the higher doses of ^{131}I, if radio injury of the glands had occurred. However, this tendency was not seen; most patients showed normal calcemia levels and no falling off of the values at higher ^{131}I doses was evident. It is concluded that hypoparathyroidism, if it occurs at all, after ^{131}I treatment of hyperthyroidism, must be a very rare occurrence. In contrast, after surgical extirpation of the thyroid gland an incidence of hypoparathyroidism of ~3% has been reported, indicating that radioiodine therapy is the preferred treatment from this point of view. (BBB)

34080 RESULTS OF CHANGES IN THE HORMONAL STATE BY RADIOTHERAPY OF ADVANCED CERVICAL CARCINOMA. Montano, Islas G.; Diaz Perches, R.; Flores, L. (Hospital Medica, Mexico City). Rev. Med. Hosp. Gen. (Mex.), 27: 509-23(1964).

Detailed results of modifications of the hormonal environment combined with radiation in the treatment of the cervix uteri carcinoma are presented. The results obtained showed that eliminating the principal sources of oestrogens surgically, or modifying with use of antioestrogenic drugs the hormonal environment in which cervix uteri carcinoma develops, causes the tissues to react more easily to the action of radiation in the form of external therapy or radium. In accordance with this working hypothesis a group of patients with cervix uteri carcinoma in advanced stages grade III and IV were submitted to bilateral ovariadrenalectomy with very favorable results never before obtained in a control group. One patient treated 6 years ago appears to be clinically cured. Three patients died three years later from surgery because they did not return to the hospital for their maintenance dose of hydrocortisone. No activity signs were found at autopsy. It is not desirable that this be

the routine treatment in this type of patient. The mechanisms modifying changes in the carcinoma are being investigated and drugs having no side effects which block the adrenal glands are being investigated. (Excerpta Med.)

34081 OPTIMAL RADIATION PROTECTION IS STILL NOT GENERALLY REALIZED IN PEDIATRIC X-RAY DIAGNOSIS. Hartung, Kurt (Jugendgesundheitspflege, Stadtgesundheitsamt, Frankfurt am Main). Roentgen Bl., 16: 157-60(May 1963). (In German)

Proper measures for protection of the gonads of infants and children from irradiation are available. However, many times their use is overlooked, or sometimes medical personnel do not make them as available for use as they should be. At present the possibilities available include improvements in the x-ray equipment and its accessories, film quality, and photographic techniques; use of Pb shields for the gonads, Pb curtains and tables with Pb plates built in; increase of the focus to skin distance; supplemental filtration; use of photography instead of fluoroscopy; continuous monitoring of patients by means of ionization chambers; sedation of the patient before irradiation; avoidance of routine, repetitious, or double exposures; etc. There are three basic rules for radiation protection in pediatric practice. The first one to remember is that the younger the child is, the more radiation protection measures are needed. The second is to avoid a large volume dose and to keep the gonadal dose as small as possible. The third is to use x-ray photography whenever it can be substituted for fluoroscopy. (BBB)

34082 ON FRACTIONATED RADIOIODINE TREATMENT OF THYROTOXICOSIS. Fridrich, R.; Walser, A. (Universitat, Basel). Schweiz. Med. Wochschr., 95: 413-16(Mar. 27, 1965). (In German)

Results obtained after 5 yr from 85 patients treated with radioiodine for thyrotoxicosis were much improved over similar experiences reported by other investigators in that the number of myxedemas produced was very low. Only one case of myxedema resulted over a period of 3 to 4 yr, but it is still possible that cases of this disorder could appear in later yr. When multiple doses were given to patients with thyroidal effective half lives of 1 or 2 days, 2 to 5 days, and 5 to 7 days, the total amounts of ^{131}I administered were from 11 to 14, 8 to 14.5, and 6.5 to 12 mC, respectively. When single treatments were given to patient groups with similar effective half lives the ranges of ^{131}I dosages used were from 9.5 to 12.5, 6 to 10, and 5 to 9.5 mC, respectively. Only 5 patients showed symptoms of recurrence of hyperthyroidism within 2 or 3 yr after the final ^{131}I treatment. The authors suggest that the effectiveness of the treatments were related to the fact that many of the patients were derived from geographical areas where goiter is endemic, and also might differ genetically from populations of other countries. (BBB)

34083 URETERAL COMPLICATIONS IN RADIATION TREATMENT OF CARCINOMA OF THE UTERINE CERVIX. Arrighi, Leoncio A.; Arrighi, Arturo A. Semana Med. (Buenos Aires), 122: 1145-8(May 30, 1963). (In Spanish)

Ureteral obstruction may be a final result in up to 10% of women treated with radiation for cervical cancer. This sequel consists of inflammatory or cicatrical stenosis of the ureter and may occur in the complete absence of residual or recurrent carcinoma. Use of Ra appears to be implicated most often in this condition. Various pathogenic factors have been implicated, including edema of the ureteral mucosa. Most cases are diagnosed three to 12 months following irradiation, the early inflammatory changes in the ureter being reversible. Hydronephrosis, seen radiologically as a distension of the proximal ureter with contrast medium, is the most obvious diagnostic criterion of ureteral stenosis, while pain in the lumbar region is the most usual symptom. Infection is a frequent accompaniment of hydronephrosis, and when the condition is bilateral, anuria may result. It is always necessary to distinguish this postirradiation complication from recurrent carcinoma. Treatment of this condition usually consists of plastic surgical repair of the radiation-damaged ureter, and this may be accomplished by several means. In cases of localized lesions, often the damaged ureteral segment can be removed and the ureter reinserted in the bladder. More extensive damage may be replaced by intestinal grafts, or the ureter may be brought through the abdominal wall (ureterostomy). Some authors have reported success with corticosteroids in preventing ureteral scarring and stenosis postirradiation. The author reports a case of ureterostenosis occurring three years after Ra (8200 mg-hr) plus x-ray treatment of cervical cancer. Corticosteroid therapy and surgical intervention in this case are considered. (BBB)

34084 THE EXPANDED RADIATION DIVISION OF THE GOETTINGEN UNIVERSITY FEMALE CLINIC. Frischkorn, Rolf (Universitaets-Frauenklinik, Goettingen, Ger.). Strahlentherapie, 127: 170-9(June 1965). (In German)

A short survey is proposed for the construction and distribution of the Radiation Division of the Department of Gynecology and Obstetrics of the University of Göttingen. The division exists of 4 groups, which are separated locally: telecobalt and conventional therapy, x-ray diagnosis with 4 units, arrangement for radium- and radiogold application, and a radiobiological and radiation physics laboratory. Necessity and methodical view points of certain details in the construction are discussed. The importance of the radiation burden with radium therapy is discussed thoroughly. Necessities for optimal radioprotective measures, based on up to date technical possibilities, are discussed. (auth)

34085 THE TISSUE REACTIONS IN IRRADIATION OF CERVIX CARCINOMA. Schmidt-Matthiesen, Heinrich (Universitaets-Frauenklinik, Goettingen, Ger.). Strahlentherapie, 127: 180-91(June 1965). (In German)

Tissue reactions were observed histologically and histochemically in 20 cervix carcinomas during radium therapy. The tissue changes depend upon the dose, distance, time, and individual variation. The following phenomena were observed: a primary degeneration zone (0 to 0.5 mm deep); a reaction zone (0.5 to 4 mm deep) with cellular, vascular and enzymatic specialities; and a latent zone (>3 to 4 mm deep). The reactions in tumor cells and cells of the connective tissue, described in detail, are initially without connections. Later on, secondary reciprocal effects can be observed in some instances. After completing therapy, vitally acting carcinoma cells in a layer 5 to 7 mm deep were frequently found. Apparently, reaction mechanisms with an extended latency time seem to be important for this effect (vessels). In addition to common radiation effects, there are some individual variations, e.g. the primary tumor size which influences the qualitative reaction in the connective tissue. (auth)

34086 THE COMBINATION OF RADIOTHERAPY OF CERVIX CARCINOMA WITH ^{60}Co – RADIUM – γ RADIATION AND THE CYTOSTATIC SP-I/SP-G. Paeschke, Karl-Dietrich (Universitaets-Frauenklinik, Goettingen, Ger.). Strahlentherapie, 127: 192-7(June 1965). (In German)

Treatment of the female genital carcinoma with the cytostatic substance SP-I/SP-G in addition to radiation therapy with radium and ^{60}Co-Ra-radiation is discussed. Leukocyte and erythrocyte values as well as well as diarrhea events occurring in these patients are compared with the ones obtained from patients who received only radiation treatment. The method of administration and dosage of SP-I/SP-G is reported. The results show, that there are no unfavorable effects when a combination of the telecobalt-radium-irradiation with SP-I/SP-G up to a dose of 12 g is used. (auth)

34087 LATE COMPLICATIONS AFTER INTRAPERITONEAL RADIOGOLD INFUSION. Johannssen, Horst (Universitaets-Frauenklinik, Goettingen, Ger.). Strahlentherapie, 127: 198-205(June 1965). (In German)

Observations were made with 15 patients which exhibited areal adhesions in the abdomen after receiving approximately 120 mCi of radiogold through intraperitoneal in-

stillation. Abdominal surgery had to be repeated in 9 cases, in 3 cases as a result of ileus and in 6 cases because of a suspected recurrence. In 6 other cases, without abdominal surgery, the symptoms were interpreted as being the same. None of the cases showed a local recurrence at the time of the repeated abdominal surgery. The majority of patients demonstrated a discrepancy between the extent of the adhesions and the symptoms. Therefore, further conclusions should be made only after a sufficient period of time. Thus it may be concluded that in favorable cases a smaller radiogold dose is sufficient, in these cases the dispersion of tumor cells seems negligible. (auth)

34088 PROGRAM FOR ISODOSE CALCULATION FOR PENDULUM, CROSS-FIRE, AND CONCENTRIC MULTIPLE-FIELD IRRADIATION ON AN ELECTRONIC COMPUTER. Rosenow, Ulf (Universitaets-Frauenklink, Goettingen, Ger.). Strahlentherapie, 127: 206-16(June 1965). (In German)

Computer programs for the calculation of dose distributions for pendulum-, concentric multiple field-, and cross fire x irradiations are given. A dose plane is printed by the computer in a 1:1 ratio. The method is based on standing field values, dose distributions of which are known for the grid points of a polar coordinate system. The use of measured or tabulated tissue-air ratios corrects differences introduced by differences in patients. The dose distributions for different layers, that is for three dimensions, as well as favorable irradiation technique can be obtained in a short period of time. (auth)

34089 CALCULATION OF STANDING-FIELD DOSE DISTRIBUTIONS FOR ^{60}Co TELETHERAPY. Schoknecht, Guenter (Staedtische Auguste-Viktoria-Krankenhauses, Berlin). Strahlentherapie, 127: 217-28(June 1965). (In German)

Equations for the calculation of the dose rate at any point in a standing field are derived, assuming that the point does not lie next to the surface. An analytical expression for the determination of the dose rate in the central beam is used for the calculation. Based on these assumptions, experimental values were used for the calculation of the dose rate for points located outside of the central beam. The method is applied for standing fields with and without wedge filters and for turned out standing fields. It is also used as a basis for the determination of the dose distribution with multifield and moving field irradiation previously described. The method might also be used for general three dimensional irradiation plans with ^{60}Co-teletherapy. (auth)

34090 SEROSAL REACTION TO ULTRAVIOLET RADIATION DURING SURGICAL PROCEDURES. Beehler, Cecil C. (North Carolina Baptist Hospital, Winston-Salem); Clay, James R. Surgery, 57: 525-7(Apr. 1965).

The use of uv radiation as a method of improving asepsis in the operating room has greatly reduced the incidence of surgical infections, but its potential hazard has not been fully investigated. Some surgeons familiar with its use feel that the incidence of adhesions may be increased. Experiments were designed to study the adhesion-producing effects, if any, of uv radiation upon serosal membranes. Dogs were subjected to laparotomy under an aseptic technique. The viscera were exposed to uv radiation for 90 to 180 min. Sterilamps, designed to give 38 μw per cm^2 of radiation at a distance of one m, were used. The animals were exposed to either the uv or control (fluorescent) lamps for either 90 (Group I) or 180 min (Groups II, III, and IV). Groups I and IV were sacrificed and autopsied at 30 days. Group II was autopsied after three days, and Group III after 14 days. The experimental animals from Group I (90 min) showed no significant lesions. The data for Groups II, III, and IV showed a statistically significant difference of both the graded and measured adhesions between the experimental and control animals for all three groups. The adhesions in Group II were extremely friable and were not measured. Similarly, analysis of the grading of histologic sections showed a significantly greater reaction in the mesentery and the intestinal serosa for the experimental animals. The omentum showed no significant difference between experimental and control animals. In view of the fact,that adhesions are the single most common cause of intestinal obstruction, and may result in repeated operations for obstruction, serious consideration should be given to any factor which would increase the incidence. These results show that prolonged exposure of serous mucosa to uv light under surgical conditions does cause a significant increase in adhesions and inflammatory changes following surgery. This factor should be included when considering the use of uv light. (BBB)

34091 BETA IRRADIATION OF PTERYGIA. Wilson, Brian (Princess Alexandra Hospital, Brisbane, Australia). Trans. Ophthalmol. Soc. Australia, 23: 96-100(1963).

Comparison is made of the use of surgery and ^{90}Sr β irradiation in the treatment of 182 cases, and the late effects of radiation on the lens were followed. Cases for irradiation were given 2200 rad in a single dose immediately after the completion of the operation. All patients were followed for at least six months and, at most, two years. This survey was made to discover whether β irradiation, which has been shown to be highly effective in the treatment of recurrent pterygia, is even more effective if used as a primary procedure, at the time of the initial excision. A five-yr series of 25 cases receiving β irradiation for pterygia from 1955 (the first year ^{90}Sr was available) was checked primarily for later lens complications. When the lenses were examined with slit lamp and ophthalmoscope under full dilatation, six (24%) showed some lens opacity, but in four (16%) this was typically senile and roughly paralleled by a similar opacity in the other eye, which was not irradiated. The other two (8%) showed a few small vacuoles under the area treated, which could have represented a minor radiation-induced change. Previous experience with the more penetrating contact x rays showed that, although in 50% of cases vacuoles and minor opacities developed after 10 yr, these changes were limited to the area treated and were not progressive. In no case was the visual axis involved. Telangiectasia was a complication with the x-ray technique; in the 25 cases treated with β rays, eight (32%) showed some telangiectasia, but only one (4%) was cosmetically apparent. Delayed epithelialization was a problem in occasional cases in the main series, producing mild photophobia, lachrymation, and irritation, but there were no cases persisting in the five-yr group. Pterygia had a high recurrence rate following simple excision (60%). This was reduced to 20% by β irradiation with 2200 rad at operation. The β-irradiation recurrence rate was the same whether the pterygium was primary or recurrent. β Irradiation did not appear to cause any serious complication over a five-yr period. It is suggested, on the basis of these findings, that pterygium should rarely be submitted to surgery unless either (1) it is already almost to the optic axis (i.e., >4 mm), or (2) it is well on its way to the optic axis (i.e., >3 mm) and has actually been observed to be growing, or (3) it is causing substantial and increasing astigmatism. When surgery must be done, using these criteria, it should be followed by an immediate application of 2200 rad of β irradiation as a primary procedure. (BBB)

34092 A CASE OF HEPATORENAL SYNDROME INDUCED BY RADIATION. Cihat, Abaoglu; Muenevver, Yenerman; Necdet, Kocak; Nidai, Atmaca S. (1st Universitesi Tip Fakultesi, Istanbul). Turk Tip Cemiyeti Mecmuasi, 29: 404-14(July 1963). (In Turkish)

An early clinical reaction to irradiation is described which was diagnosed as hepatorenal syndrome. This condition is defined and differentiated from others which involve the liver and kidney simultaneously, such as Weil's disease and carbon tetrachloride poisoning. The injurious effects of ionizing radiation on the liver and kidney, as reported in previous publications, are reviewed and described in detail. This survey shows that renal injury from irradiation occurs more frequently than liver damage, which has only rarely been reported. In the case report presented here a 37-yr-old woman had undergone surgical removal of a uterine carcinoma four months previously, which had been followed by radiotherapy. She had received a total of 1000 R given in four

sessions over a period of one week. Immediately after irradiation she experienced weakness, chills, and fever, and jaundice developed as seen in the conjunctiva. Thirteen days later the jaundice disappeared, but she developed anuria, hypertension, and uremia. She died 23 days after jaundice was noted, in spite of intensive treatment, in a crisis described as hypertensive encephalopathy. Post mortem examination revealed incipient cirrhosis of the liver, with fresh and old necroses and hemorrhages in hepatic tissue. The kidneys showed tubular necrosis, interstitial tissue proliferation, glomerular hyalinization, and arteriolar sclerosis. These histopathologic findings suggested that the liver and kidney lesions had a similar origin, namely, irradiation as the etiologic factor. It was therefore concluded that pelvic irradiation in this case had induced the hepatorenal syndrome. No previous reports could be found in the medical literature of postirradiation development of this syndrome. (BBB)

34093 ROENTGEN THERAPY FOR CAROTID SINUS SYNCOPE. Aravanis, Christ; Antonakis, E. (Univ. of Athens, Greece). Vascular Diseases, 1: 119-21(Mar. 1964).

The use of x-ray treatment is described with reference to a patient who suffered from carotid sinus syncope attacks when he turned his head to the left. Irradiation of the carotid sinus area abolished completely the syncopal attacks. All specific drugs tested, such as atropine, epinephrine, and isoproterenol, in high doses were without any significant effect. Electrocardiograms (ECG) taken during the syncope showed severe bradycardia or ventricular asystole. The blood pressure remained stable during the attacks of bradycardia. With pressure on the carotid sinus the same effect could be obtained, and the ECG showed, during this procedure, an extreme slowing of the ventricular rate. Progressively, the P-R interval increased and finally ventricular asystole was developed and the patient lost consciousness. After the diagnosis of carotid sinus hypersensitivity, elicited by turning the head to the left, the patient was given two x-ray treatments on alternate days to each carotid sinus area of 200 R measured in air. The total was 800 R for both sides in one week. When the patient was discharged from the hospital he was free of syncopal attacks upon turning his head. (BBB)

34094 RADIOISOTOPES IN TROPICAL MEDICINE. World Health Organ., Chron., 17: 83-96(Mar. 1963).

Numerous applications of radioisotopes in biological and medical problems of the tropics are reviewed. In tropical medicine four phenomena appear repeatedly in varied combination: infection, diarrhea, malnutrition and anemia. Infection and malnutrition interact particularly closely. Isotope techniques have proved invaluable in studies of every aspect of water and electrolyte physiology, the most useful method so far being based on the dilution principle. Sodium-24, ^{42}K, and ^{82}Br (used as a chloride substitute) and deuterium or tritium are the isotopes most often employed in such studies. Some results of studies with a new isotope, ^{28}Mg, suggest that the correction of magnesium depletion in cholera is an essential prerequisite to the correction of potassium loss. Radioisotopes such as ^{55}Fe, ^{59}Fe, ^{51}Cr, and vitamin B_{12} labeled with radiocobalt have proved useful in the analysis and separation of conditions that exist in South-East Asia. These isotopes facilitate the study of hemolysis by providing estimates of the life span of red cells and the pattern and sites of their destruction. A table shows the various isotopes that have been incorporated into insects. Those most often used for ecological investigations are the β emitters ^{32}P, ^{35}S and ^{89}Sr. Tracer techniques and insect biochemistry are also discussed, whereby the use of radioactive labeled insecticides enables their metabolic fate in insects to be followed with great sensitivity and specificity, and throwing much light on the mechanism of insect resistance. (TCO)

34095 TREATMENT OF UNAVOIDABLE RADIATION REACTIONS IN GYNAECOLOGICAL THERAPY. Scholl, O.; Weishaar, J. (Universitaet, Erlangen, Ger.). Z. Aerztl. Fortbild., 53: 565-74(1964).

A practical survey is given of the treatment of disorders during radiation-therapy of malignant gynaecological diseases. A detailed description is given of the drugs employed and their mode of application. (Excerpta Med.)

34096 MODEL STUDIES WITH RADIONUCLIDE LABELING OF ANTIBODIES AGAINST BORDETELLA PERTUSSIS. Ocklitz, H.-W.; Herzmann, H.; Weppe, Ch. M. (Forschungsgemeinschaft, Deutsche Academie der Wissenschaften, Berlin). Z. Immunitaetsforsch., 127: 428-35 (1964). (In German)

A procedure is described for labeling antibody prepared from immunized rabbits. Radioiodine (^{131}I, 7 mC) was incubated with 0.42 g of rabbit γ-globulin for 2 hr at 37°C. The labeled anti-Bordetella pertussis globulin that resulted had a concentration of 0.276 mC/ml of solution, and there were 6×10^{15} globulin molecules present in each 0.1 ml of the solution. At the time of labeling it was estimated that ^{131}I was found to ~6000 of these antibody molecules. Paper electrophoretic studies of the labeled antibodies indicated that they could be separated readily from the bacterial agglutinate if the paper was pretreated with human globulin, and the labeled globulin was chromatographed immediately after application of the sample, without it being permitted to dry. The results indicated that it would be feasible to use radioactively labeled antibody as a substitute for fluorescence labeling of antibody for serological assay of antigens. Automation of the test is thereby facilitated since a Geiger-Mueller counter can be used to measure antigen-bound radioactive antibody, rather than resorting to optical examination as with the fluorescence method. (BBB)

34097 OXYPHENBUTAZONE IN THE RADIATION TREATMENT OF UTERINE CARCINOMA. Pauwen, J. (St. Clemens Hospital, Geldern, Ger.). Zentr. Gynaekol., 86: 468-70(Apr. 4, 1964). (In German)

Oxyphenbutazone (Tanderil) was used for its antifebrile properties to reduce the degree of temperature increase and inflammatory reaction that accompanies use of Ra implants used to treat uterine carcinoma. The oxyphenbutazone treatment consisted of 100 mg given three times a day. This treatment schedule was well tolerated by all of the patients. Out of 98 cases treated in this manner only 6 patients had a temperature of over 38°C. Cystitis and proctitis were observed very rarely during and after the irradiation, so that the x-ray dose could be increased. The patients were treated with two Ra implants, each of which was 3000 mg-hr. The implantations were made at an interval of 28 days. During this interval the parametrium was intensively irradiated with total doses that ranged from 7000 to 11000 R, depending on the sensitivity of the patient. Tanderil is a metabolite of butazolidine with very little toxicity. It can be used in combination with antibiotics and sulfonamides. There are a few contraindications for its use. These are leukopenia, renal or cardiac failure, or gastrointestinal ulcers. Tanderil, when given during the preoperative irradiation of uterine and mammary cancer, also reduces the inflammatory cell infiltration of the tissues and the skin. It also appears to improve the postoperative healing processes. (BBB)

34098 BIOLOGICAL, MEDICAL, AND ENVIRONMENTAL RESEARCH PROGRAM. CURRENT MAJOR ADVANCEMENTS. p. 183-201 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Major advancements in research in the fields of biology, medicine, and the assay of environmental contamination by radioactive fallout during 1964 are reviewed. Brief summaries are presented of results of studies of genetic factors involved in salt-induced hypertension in which ^{22}Na was used in studies on NaCl metabolism; studies of bone mineral content using ^{125}I as a tracer and external counting of a single finger bone; the development of computer methods for computation of radiation distribution within a cancer patient undergoing rotational therapy with x or gamma rays; the use of a linear accelerator with pencil beam for the high-energy treatment of cancers; the use of ^{60}Co-vitamin B_{12} and arm counting in the diagnosis of chromic myelogenous leukemia; the effects of therapeutic treatment with diethylenetriaminepentaacetic acid on in-

testinal excretion of Pu; the isolation and transplantation of bone marrow cells in mice in studies of the role of bone marrow lymphocyte-like cells in the repopulation of depleted blood-forming tissues of irradiated recipients; the nature of reparable radioinduced chromosome lesions in Paramecium; the somatic effects of radiation in man based on a medical survey of the populations of Hiroshima and Nagasaki exposed to the effects of atomic explosions; the pathology of lens opacities in mice at various times after exposure to low and divided doses of monoenergetic fast neutrons or x rays; radioinduced leakage of intravenously injected ^{131}I-polyvinylpyrrolidone into the intestinal tract of rats after exposure to fission neutrons; chromosome abnormalities in mice with radioinduced leukemia; molecular repair mechanisms in ultraviolet irradiated cellular DNA; studies of the Mössbauer spectra of molecules of biological origin containing one or more atoms of a metal; the development of silicon diode detectors for low-energy x and γ measurements and Li-drifted Ge detectors of measurements of high-energy γ radiation; the development of instruments for use in studies of the color and time course of delayed light in illuminated plants and the relation of delayed light to fluorescence; the development of a low-level multidimensional γ spectrometer for use in coincidence measurements of characteristic photons of radionuclides in a mixture; the development of an automated recording densitometer for use in film badge processing and data recording; and the development of procedures for measuring atmospheric radioactivity and fallout. (C.H.)

34099 CLINICAL RADIOISOTOPE SCANNING TECHNIQUES. p.237-64 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Recent developments in the applications of radioisotopes in clinical diagnostic studies are reviewed. Emphasis is placed on the development for equipment for use in scanning including whole-body scanners, special scanning systems for high-energy γ scanning, section scanners, autofluoroscope; low-energy brain scanners, hybrid radioisotope scanners, scintillation cameras, positron scanners, image intensifiers, collimators, data recording systems, equipment for contrast enhancement, and the development of scanning agents and compounds of value for the differential deposition of radioisotopes in organs and tissues. Localizing agents discussed briefly include ^{203}Hg-chlormerodrin for use in brain scanning; ^{131}I-Rose Bengal and ^{198}Au colloids for use in liver and bone marrow scanning; ^{131}I-serum albumin for spinal cord scanning; ^{75}Se-selenomethionine for use in pancreatic scanning; ^{18}F for use in bone scanning; ^{131}I-colloidal aggregates of human serum albumin of various sizes for use in scanning the heart, lungs, liver, spleen, brain, kidneys, stomach, and salivary glands; ^{59}Fe for use in bone marrow scanning; the use of ^{131}Cs for heart muscle scanning; ^{74}As for positron scanning for the localization of brain tumors; ^{125}I for thyroid scanning; and ^{99m}Tc, ^{68}Ga, and ^{137m}Ba for use in a number of clinical diagnostic tests. Data readout techniques and computer analysis of counting data are discussed. (C.H.)

CHEMISTRY

General

Refer also to abstracts 35603, 35613, and 35615.

34100 (ORNL-3812(p.121-68)) CHEMISTRY. (Oak Ridge National Lab., Tenn.).

Equilibrium phase behavior was examined in systems of relevance to molten-salt reactor technology. A three-dimensional model of the $LiF-BeF_2-ZrF_4$ phase diagram was constructed to afford a display of the crystallization behavior of the MSRE fuel and coolant salt. The $LiF-BeF_2$ system was examined using very pure mixtures of LiF and BeF_2. Refinement in the liquidus values was achieved. The phase diagram of the system UF_3-UF_4 was constructed as a part of a study of $UF_3 \rightleftharpoons UF_4$ high-temperature equilibria. The system was found to be characterized by a substantial solid solubility of UF_4 in UF_3. Transpiration measurements of the reactions between H_2O-HF mixtures and molten-salt mixtures were extended to mixtures of $LiF-BeF_2-ZrF_4$ in order to learn more about the behavior of oxides as contaminants in molten-salt fuel systems. The potential advantages of the use of $HF-H_2$ mixtures for on-stream or side-stream sparging of molten-salt reactor fuels are being explored. The stability of UF_3, both as a solid in the presence of solid UF_4 and as a dissolved component of molten fluoride mixtures containing LiF and BeF_2, was studied through measurements of the equilibrium pressures of HF and H_2 associated with the equation, $H_2 + UF_4 \rightleftharpoons UF_3 + HF$. Equilibrium quotients indicate that the disproportionation of U(IV) to U(O) + U(III) in molten-salt reactor fuels has a much smaller tendency than was previously predicted; melts containing 0.5 mole % each of UF_3 and UF_4 at 1000°K are indicated to be in equilibrium with U metal at the very low activity of 1.5×10^{-7}. Further study of the viscosity of $LiF-BeF_2$ mixtures shows that the activation energy for viscous flow decreases sharply from 58.5 kcal/mole for pure BeF_2 to 9.5 kcal/mole for 36 mole % BeF_2, while the viscosity at 600°C drops from 63,800,000 to 11.3 centipoises over the same composition range. The production of coolant- and flushing-salt mixtures for the MSRE was completed. Chemical support to the MSRE during prenuclear operations has included arrangements for and interpretation of chemical analyses of the fluoride mixtures added to the reactor and arrangements for determining the changes in chemical composition of the composited flushing and coolant salt during about 1000 hr of prenuclear operation. Development and evaluation of equipment for analyzing MSRE fuel samples were continued. (J.R.D.)

34101 CHEMISTRY RESEARCH. p.36-55 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Research is reported in nuclear chemistry, radiation chemistry, high-temperature chemistry, theoretical and structural chemistry, physical chemistry, inorganic chemistry, analytical chemistry, systems and materials chemistry, separations chemistry, isotopic geochemistry, and isotopic effects in organic chemistry. (T.F.H.)

Analytical Procedures

See also Separation Processes and Procedures.

Refer also to abstract 34470.

34102 (BNWL-SA-3) STATISTICAL CONTROL OF MEASUREMENT QUALITY. Bennett, C. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1965. Contract AT(45-1)-1830. 20p. (CONF-650803-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI

From IAEA Symposium on Nuclear Materials Management, Vienna.

The design and operation of material control systems depend on the quality of the quantitative data on which they are based. A treatment is presented of the use of statistical analysis to evaluate and/or control the accuracy and reliability of measurement methods. Errors and bias are covered. (D.L.C.)

34103 (CEA-R-2545) CHROMATOGRAPHIES FRONTALE ET DE DEPLACEMENT DE BANDE DES ISOTOPES DE L'HYDROGENE SUR PALLADIUM. (Frontal and Band Displacement Chromatography of the Hydrogen Isotopes on Palladium). Botter, Fernande; Menes, Janine; Tistchenko, Serge; Dirian, Gregoire (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1965. 88p. Dep.(mn).

As a result of hydrogen isotope separations that were carried out on supports containing palladium, a double contribution, theoretical and experimental, to the work which has already been published in this field, is reported. From the fundamental point of view the validity of a simple model, a separation coefficient α which is very different to unity, was developed and studied. This model, which is of a counter-current isotopic exchange, neglects the longitudinal diffusion in the gas phase and the lateral diffusion in the adsorbed phase and only takes into account the surface resistance to exchange between the phases. It is therefore possible to estimate the efficiency of a chromatographic column in terms of the height equivalent of a theoretical plate (HETP). The slight differences observed between the actual chromatograms and the simple model justify both the research undertaken into a more complex model taking into account the diffusion, and the adoption of a simple model for comparing the efficiency of several columns. A new and simple graphical method for deducing the number of theoretical plates of a column in chromatograms of the frontal and band displacement types is also described. The experimental criteria for the validity of the model used, the law as a function of the $\alpha_{H_2\text{-}HD}$ temperature, the study of the HETP as a function of the various parameters on several palladium-containing supports, and the possibilities of an application to preparative chromatography are given. (auth)

34104 (JINR-P-2159) ADSORBTSIYA ASTATINA NA PLATINE IZ AZOTNOKISLYKH RASTVOROV. (The Adsorption of Astatine on Platinum Metal From Nitric Acid Solutions). Norseev, Yu. V.; Chao, Tao-nang; Khalkin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 14p. Dep.(mn).

Astatine spontaneously deposits on platinum metal covered with an oxide layer from nitric acid solution containing dichromate ion. The extent of the adsorption is in direct proportion to the surface of platinum and the time of the process, but is inversely proportional to the volume and acidity of the solution. Tl^+, Hg^{2+}, Bi^{3+} ions (probably BiO^+) and Cl^- interfere with this process. In the latter case astatine forms a negatively charged chloride complex $[(Atx)Cl_2]$, $K_2 = (1.35 + 0.13) \cdot 10^{-6}\ M^{-2}$. (auth)

34105 (LA-3305) THE X-RAY FLUORESCENCE SPECTROMETRIC DETERMINATION OF CADMIUM IN SILVER-CADMIUM-COPPER ALLOYS. Hakkila, E. A.; Hurley, R. G.; Waterbury, G. R. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Apr. 19, 1965. Contract W-7405-eng-36. 17p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Cadmium in silver–cadmium–copper alloys is determined using an x-ray fluorescence method in which 500 mg of the alloy are irradiated using a tungsten target x-ray tube. The intensity of the Kα line for cadmium corrected for background is compared to corrected intensities measured for solutions of known cadmium content. The method is applicable to the determination of cadmium concentrations of 0.2 to 28% with relative standard deviations in the range from 25 to 0.7%. (auth)

34106 (ORNL-3810) ALPHA—A COMPUTER PROGRAM FOR THE DETERMINATION OF RADIOISOTOPES BY LEAST-SQUARES RESOLUTION OF THE GAMMA-RAY SPECTRA. Schonfeld, E. (Oak Ridge National Lab., Tenn.). July 1965. Contract W-7405-eng-26. 44p. Dep.(mn); $3.00(cy), 1(mn) CFSTI

A FORTRAN-63 computer program, ALPHA, was developed for the quantitative analysis of radioactive samples by the least-squares resolution of the gamma-ray spectra. As the result of thousands of analyses, ALPHA was found to be fast, accurate, and relatively inexpensive. This report describes the main feature of ALPHA and shows how to use it. The program was designed to handle a small or large number of samples. The samples can have different radioactivity levels (from 0.1 to 10^4 counts/sec), isotope compositions, and input formats. Also, they can be on cards or magnetic tape. ALPHA takes into account several corrections such as: background subtraction, counting time, decay, dead time, automatic compensation for gain and threshold shifts, sample fraction, volume reduction prior to counting, etc. Typical computation times for samples containing from 6 to 10 isotopes are about 5 to 15 sec. The cost per analysis is about 20 cents (this includes only the CDC-1604 computer charges and not the cost of sample preparation and counting). (auth)

34107 (ORNL-3821) IDENTIFICATION OF CARBIDES, NITRIDES, AND OXIDES OF NIOBIUM AND NIOBIUM ALLOYS BY ANODIC STAINING. Crouse, R. S. (Oak Ridge National Lab., Tenn.). July 1965. Contract W-7405-eng-26. 11p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

A method was developed for the identification of some impurity phases in niobium and niobium alloys. It is based on the principle that an anodic oxide film formed on niobium produces interference colors. The color is characteristic of the anodic oxide thickness which in turn depends upon the composition of the substrate. These color differences can be used to identify carbides, nitrides, and oxides. Using specimens containing known phases, a technique was developed to identify these phases in unknown specimens. Weak solutions of organic acids were found to be the most satisfactory electrolytes for anodization, although other electrolytes can be used. Clear colors were produced and good control was possible with individual solutions of lactic, citric, and oxalic acids, or mixtures of these. (auth)

34108 (ORO-627) A STUDY OF FLUORESCENT EXCITATION USING ISOTOPIC X-RAY EMISSION. Martin, Troy C.; Blake, Kenneth R. (Texas Nuclear Corp., Austin, Tex.). Mar. 31, 1965. Contract AT(40-1)-3224. 64p. Dep.(mn); $3.00(cy), $0.75(mn) CFSTI

Some of the factors affecting the sensitivity of the isotopic x-ray fluorescent technique of elemental analysis have been studied. These include matrix or interelement effects and in more detail the source geometry and the low energy x-ray absorption in air and in the spectrometer window. It was found by using a gas proportional counter with a 0.5 mil beryllium window in a helium atmosphere that fluorescent x rays as low in energy as 1 kev could be detected. An increased efficiency of a factor of 30 for 1 kev x rays in helium compared to air was obtained. In addition it was determined that by using a different source geometry, the sensitivity could be increased by an order of magnitude over the conventional source-on-window geometry normally employed in isotopic fluorescent analysis work. With a donut source geometry, a calibration curve was obtained for sulfur in powdered graphite in the range of from 0.1 to 10% by weight with good statistical accuracy. (auth)

34109 (RFP-564) A COMPUTER PROGRAM TO CONVERT GAS ANALYSIS DATA FROM UNITS OF VOLUME PERCENT TO MOLAR QUANTITIES. Larson, C. A. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). June 18, 1965. Contract AT(29-1)-1106. 13p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

A computer program was prepared, for use on the ASI-210 digital computer, which will convert gas analysis data from units of volume percent to molar quantities. (auth)

34110 (RL-SA-38) A REFINED SPECTROPHOTOMETRIC DETERMINATION OF URANIUM WITH 1-(2-PYRIDYLAZO)-2-NAPHTHOL. Anderson, D. L.; Smith, H. E. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). May 19, 1965. Contract AT(45-1)-1350. 13p. (CONF-650613-2) Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From American Chemical Society, 20th Northwest Regional Meeting, Corvallis, Ore.

A virtually specific procedure was developed for the spectrophotometric determination of uranium. The specificity of the procedure depends on the fact that by the proper choice of conditions, uranium can be quantitatively separated from the majority of potentially interfering ions by solvent extraction with tri-n-octylphosphine oxide. In addition, it was shown that it is possible to determine uranium directly in organic matrices such as TBP, DBP, D2EHPA, and hexone. (auth)

34111 (TID-7022(Vol.I)(Bk.6)) ANALYTICAL CHEMISTRY MANUAL OF THE FEED MATERIALS PRODUCTION CENTER. SAMPLES FROM THE SAMPLING PLANT: KILN ASH THROUGH VITRO-CANONSBURG CONCENTRATE. (National Lead Co. of Ohio, Cincinnati). Dec. 1964. Contract AT(30-1)-1156. 311p. Dep.(mn); $5.50(cy), 5(mn) CFSTI

Modifications of general wet-chemical methods are presented for specific sample types from the sampling plant. The sample types covered include ashes, leach tank sludge, MgF_2 slag, metal oxide, off spec U_3O_8, ore cleanup, Porter Brothers, Portuguese concentrate, prepared feed, Q-11 ore, scraps, screen fractions, South African Calprod and concentrate, sump cake, U. S. phosphoric products, Virginia Carolina, and Vitro-Canonsburg. (D.L.C.)

34112 (TID-7022(Vol.I)(Bk.7)) ANALYTICAL CHEMISTRY MANUAL OF THE FEED MATERIALS PRODUCTION CENTER. SAMPLES FROM SOURCES 2 THROUGH 5 (REFINERY THROUGH METALS REDUCTION PLANT). (National Lead Co. of Ohio, Cincinnati). Dec. 1964. Contract [AT(30-1)-1156]. 438p. Dep.(mn); $4.50(cy), $2.00(mn) CFSTI

Modifications of general wet-chemical methods are presented for samples from the refinery, denitration plant, green salt plant, and metals reduction plant. (D.L.C.)

34113 (TID-7022(Vol.I)(Bk.8)) ANALYTICAL CHEMISTRY MANUAL OF THE FEED MATERIALS PRODUCTION CENTER. SAMPLES FROM SOURCES 6 THROUGH 14 (METAL FABRICATION PLANT THROUGH CO-OP SAMPLES). (National Lead Co. of Ohio, Cincinnati). Dec. 1964. Contract AT(30-1)-1156. 346p. Dep.(mn); $3.50(cy), $1.75(mn) CFSTI

Modifications of general wet-chemical analytical methods are presented for samples from the metals fabrication plant, recovery plant, special products plant, and pilot plant. Service and co-op samples are also covered. (D.L.C.)

34114 (WAPD-T-1662) SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS OF SOME NICKEL AND IRON BASE ALLOYS. Cook, H. D.; Kessler, T.; Beeles, L. T. (Bettis Atomic Power Lab., Pittsburgh, Pa.). June 1964. Contract AT-11-1-GEN-14. 20p. (CONF-649-28). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From 12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964.

Changes were observed in the metallurgical properties of various non-fuel alloys used to fabricate components for the Shippingport Atomic Power Plant. To explain the changes in metallurgical properties, variations in the chemical composition of the alloys were investigated. Because of the small size of the samples available, a spark source mass spectrographic method for the analysis of the alloys was developed. The analyses of all elements ranging in concentrations from 0.1 ppm to that of major constituents were accomplished on one plate. Several instrumental techniques and methods of computation were used to increase the reliability of the determination of individual elements. The results obtained by the spark source mass

spectrographic method compared favorably with the results obtained by wet chemical analyses. (auth)

34115 (Y-1482) DETERMINATION OF SUBMICROGRAM QUANTITIES OF MERCURY IN LITHIUM METAL, ITS HYDRIDE, OR HYDROXIDE. Dietrich, W. C. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Apr. 1, 1965. Contract W-7405-eng-26. 17p. Dep.(mn); $2.00 (cy), 1(mn) CFSTI

A method has been developed for determining submicrogram quantities of mercury in lithium metal, lithium hydride, or lithium hydroxide. Mercury was concentrated as the dithizonate from an acetate system by a dithizone–chloroform extraction, then determined spectrophotometrically as liberated dithizone after dissociating the mercury dithizonate with potassium iodide. (auth)

34116 THE RAPID DETERMINATION OF CARBON IN STEELS BY MEASUREMENT OF THE PROMPT RADIATION EMITTED DURING DEUTERON BOMBARDMENT. Pierce, T. B.; Peck, P. F.; Henry, W. M. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Analyst, 90: 339-45 (June 1965).

A rapid, nondestructive method was developed for determining carbon in steels, based on measurement of the 3.1-Mev prompt γ rays emitted during deuteron bombardment. Steel samples with carbon contents in the range from 0.04 to 0.69% were irradiated for ~180 seconds, and a linear relationship found between the yield of 3.1-Mev prompt γ rays and the known carbon content of the samples. (auth)

34117 ISOTOPE STRUCTURE OF URANIUM LINE U I 5027.4 A AND ITS USE FOR ISOTOPE ANALYSIS. Berthelot, Ch. A.; Lauer, K. F. (EURATOM, Geel, Belg.). Appl. Spectry., 19: 84-6(1965).

Experiments on the isotope shift of ^{238}U, ^{236}U, ^{235}U, ^{234}U, and ^{233}U in the uranium emission line U I 5027.4 Å were made using the photoelectric interferometer Hypeac. The ratios $^{235}U + ^{234}U/^{238}U$ and $^{233}U + ^{234}U/^{238}U$ can be determined with the automatic electronic integrator. The possibility of interference between the lines ^{235}U 5027.295 Å and ^{236}U 5027.338 Å is discussed. (auth)

34118 MERCURY-204 DETERMINATION BY EMISSION SPECTROSCOPY. Smith, F. M. (Battelle-Northwest, Richland, Wash.). Appl. Spectry., 19: 87-9(1965).

The determination of ^{204}Hg was made by using the isotope shift of the 3984Å mercury line excited by an electrodeless discharge. Densitometric traces were made from film recordings of the 2984Å line and the areas under the component peaks were determined. Ratios of each of these areas to the sum of the areas from all the line components were plotted against the isotope concentration to produce a working curve. The coefficient of variation for this method was approximately 11%. The time required for a single determination (after fabrication of the discharge lamp) was about two hours. (auth)

34119 ACTIVITY MEASURING ON THIN LAYER CHROMATOGRAMS. Boucke, G. (Forschungsinstitut der Telefunken AG, Ulm, Ger.). Atompraxis, 11: 263-7(May 1965). (In German)

Problems arising when a chromatogram is scanned and its activity is measured by a count rate meter are discussed. With gas flow counters, which are especially suitable for this purpose, a counting efficiency of about 5% is obtained for ^{14}C and ^{35}S. For ^{3}H a windowless gas flow counter gives an efficiency of 1%, approximately. The scanning speed should be equal to collimator slot width divided by 2 times integrating time constant. Measuring time can be shortened by automatic change of the scanning speed controlled by the count rate. Hints are given for detecting low activities, for obtaining the total count of a spot, and for two-dimensional techniques. (auth)

34120 CARRIER-FREE ^{224}Ra(ThX) FROM ^{228}Th(RdTh) BY ION-EXCHANGE ON ZIRCONIUM HYPOPHOSPHATE. Koenig, K.-H.; Hoyer, F. (Universitaet, Frankfurt am Main). Atompraxis, 11: 275-7(May 1965). (In German)

Through the high specificity of zirconium hypophosphate for the adsorption of thorium a simple separation of carrier-free ^{224}Ra (ThX) from ^{228}Th (RdTh) is possible. The dependency of the radiochemical purity and yield of ^{224}Ra from the concentration of the eluant hydrochloric acid was investigated. ^{224}Ra is easily eluted from adsorber columns by 0.5N or stronger hydrochloric acid. Radiochemical purity is better than $1:5 \times 10^6$ in respect to ^{228}Th. Columns loaded with ^{228}Th are generators for the production of ^{224}Ra. (auth)

34121 SEALED NEUTRON SOURCE. de La Barre, F. Genie Civil, 141: 117-19(1964).

A tube generator for use in qualitative and quantitative nondestructive activation analysis is described. The source permits determination of: 0.01% of S, P, Cr, Mn, Si, and C in iron and steel; non-ferrous metals in alloys such as Cu–Sn, Cu–Zn, and Al–Si; 0.1% of S and Pb in petrol; and metals in motor oils. (P.C.H.)

34122 POLAROGRAPHIC DETERMINATION OF ZIRCONIUM AND HAFNIUM. Zakharov, M. S.; Stromberg, A. G. Izv. Tomsk. Politekh. Inst., 112: 143-7(1963).

The polarographic behavior of Zr^{4+} and Hf^{4+} at a dropping-mercury electrode in aqueous and alcoholic solutions was studied. In a basal solution of 0.1M methanolic LiCl, Zr gave a clear wave ($E_{\frac{1}{2}} = -1.4$ v). Clear waves were also obtained for Zr in absolute ethanol (basal solution 0.1M in LiCl) and in aqueous solutions (basal solution 0.1M in KCl), with the height of the wave in aqueous solutions ≃4 times that in ethanolic solutions. An increase in acid concentration increased the wave height for Zr. No interference was caused by Ca or Mg in methanolic solutions; Ti, Fe, and Al interfered. The reduction wave of Hf was obtained in a basal solution of LiCl at pH 3.5, but, under these conditions, Hf was partly hydrolyzed, whereas, in a more acid medium, the wave for Hf merged with the wave due to reduction of H^+. (Anal. Abstr., 12: (May 1965)).

34123 RADIOACTIVE CONTAMINATION OF CONTEMPORARY LEAD. Weller, Richard I. (Franklin and Marshall Coll., Lancaster, Penna.); Anderson, Ernest C.; Barker, John L., Jr. Nature, 206: 1211-12(June 19, 1965).

An investigation was made to determine the nature of the contamination of lead and the possible commercial availability of nonradioactive lead for shielding sensitive γ counters. The internal consistency of all the data obtained suggests that the contaminant is a single radioisotope, ^{210}Pb, in equilibrium with its daughter products, ^{210}Bi and ^{210}Po. Such contamination can be expected in lead derived from ores associated with U, since ^{210}Pb is a member of the ^{238}U series. However, in view of the variability of lead samples and the lack of standard specifications and methods of analysis applicable at these very low levels of contamination, it is not possible to ensure a priori the quality of a given source. (P.C.H.)

34124 ISOTOPIC SHIFT IN THE SPECTRUM OF NEON. Odintsov, V. I. Opt. Spectry. (USSR) (English Transl.), 18: 205-6(Mar. 1965).

Translated from Opt. i Spektroskopiya, 18: 357-9(Mar. 1965).

The isotopic shift $^{20}Ne-^{22}Ne$ was measured for 18 spectral lines of 1s–2p transitions. An atomic beam was used as the light source. It emitted narrow lines and thus provided higher accuracy than previous investigations. The results obtained were compared with theoretical calculations. (auth)

34125 EVALUATION OF β-RAY ABSORPTION IN PHARMACEUTICAL ANALYSIS. Sarsunova, M.; Toelgyessy, J.; Dillinger, P. Pharmazie, 19: 120-3(1964).

The beta particles from a 1-mC source (^{90}Sr) were allowed to pass upward through the sample solution contained in a Plexiglas cell ≃7 cm in diameter with a polyvinyl chloride base to a scintillation counter mounted above the sample. The logarithm of the transmitted intensity of radiation is a rectilinear function of the concentration of the sample solution. In five determinations each on 10-ml samples of 48 to 52% $CaCl_2 \cdot 6H_2O$ solution and 8 to 11% $ZnSO_4 \cdot 7H_2O$ and $CuSO_4 \cdot 5H_2O$ solutions, the maximum relative error was ≃±1.8%. (Anal. Abstr., 12: (May 1965))

34126 STUDY OF THE PLUTONIUM(IV)-ARSENAZO I COMPLEX AND ITS APPLICABILITY TO THE ANALYTICAL CHEMISTRY OF PLUTONIUM TRACES IN SOLUTION. Perez-Bustamante, J. A.; (Junta de Energia Nuclear, Madrid). Radiochim. Acta, 4: 61-6(June 1965).

A spectrophotometrical investigation of the tetravalent plutonium-arsenazo I complex was undertaken with the purpose of studying its analytical usefulness for the routine determination of trace amounts of plutonium in solution. A number of classical spectrophotometrical methods were used throughout this investigation with varying success due to the complexity of the system. In some instances full oxidation of the lower plutonium valence state towards the tetravalent state brought about by the arsenazo under certain acidity conditions and great excess of the reagent could be detected. A method for the routine determination of plutonium traces in solution is outlined. (auth)

34127 DETERMINATION OF IODINE, BROMINE, AND CHLORINE IN ATMOSPHERIC SAMPLES BY NEUTRON ACTIVATION ANALYSIS. Duce, Robert A.; Winchester, John W. (Massachusetts Inst. of Tech., Cambridge). Radiochim. Acta, 4: 100-4(June 1965).

Iodine, bromine, and chlorine were determined by pile neutron activation in aqueous atmospheric samples. About 8 ml of aqueous sample were irradiated, short-lived ^{38}Cl, $^{80}Br + {}^{80m}Br$, and ^{128}I were separated using carriers, selective oxidation and reduction, and CCl_4 extraction. Beta radioactivity was counted from solid silver halide sources. Six or seven samples per day can be analyzed with 5% accuracy. (auth)

34128 PACKAGING LIQUID SAMPLES FOR REACTOR NEUTRON IRRADIATION. Winchester, John W.; Hashimoto, Yoshikazu (Massachusetts Inst. of Tech., Cambridge). Radiochim. Acta, 4: 108-9(June 1965).

In neutron activation analysis, irradiation of samples and standards as aqueous solutions is often preferable to solids for several reasons such as elimination of self-shielding errors. However, reactor irradiation of liquid samples requires containers with a minimum possibility of leakage during irradiation. In the MIT Reactor a pneumatic tube facility is used for irradiation. A sample is washed clean with acetone, sealed in a clean polyethylene bag, and stored in a paper wrapper until time for irradiation in the pneumatic tube. The samples are placed in a heat-sealed polyethylene box to further contain the solution in case of a leak in the bag. Heating of samples by γ rays was negligible, and slight evolution of gas in the sample solutions during irradiation did not cause difficulties. (F.J.H.)

34129 APPLICATION OF LITHIUM-DRIFTED GERMANIUM SOLID-STATE DETECTORS TO THE DETERMINATION OF HAFNIUM IN ZIRCONIUM OXIDE BY ACTIVATION ANALYSIS. Girardi, Francesco; Guzzi, Giampaolo; Pauly, Jules (Joint Nuclear Research Center, Ispra, Italy). Radiochim. Acta, 4: 109-10(June 1965).

Samples (about 0.1 g of zirconium oxide) were irradiated for two hours in the reactor in a flux of about 2×10^{13} $n/cm^2/sec$. The irradiated capsule was then left for 2 to 7 days to allow for the decay of the short-lived interfering radioactivities, especially that of $^{97}Zr + {}^{97}Nb$. Then the radioactivity was measured by means of a lithium-drifted germanium detector. The gamma spectrum of an irradiated sample of zirconium oxide containing 90 ± 3 ppm of hafnium is shown. (F.J.H.)

34130 THE ANALYTICAL CHEMISTRY OF THORIUM. II. THE SEPARATION OF TRACE AMOUNTS OF THORIUM BY COPRECIPITATION WITH CERIUM(IV) IODATE. Yen, Jen-yin; Zhu, Guei-yun (Peking Univ.). Sci. Sinica (Peking), 14: 723-8(May 1965).

By the use of the photometric method with Arsenazo I and ^{234}Th as a tracer, it was verified that 0.1 to 50 μg of thorium in a volume of 15 to 50 ml of 0.5–1.0$\underline{N}$ nitric acid solution can be completely coprecipitated with cerium(IV) iodate formed by 3–5 mg of cerium. When the volume is larger, quantitative isolation of thorium can be achieved by adding 3 mg of cerium(IV) salt to the filtrate for a second coprecipitation. Most common elements, uranium, and rare earth elements do not interfere. This method is especially suitable for the separation and determination of traces of thorium in the presence of large amounts of rare earth elements. When considerable quantities of titanium, zirconium, tin, etc., are present, the iodate precipitate may be dissolved and reprecipitated as oxalates, thus freeing itself from the interfering elements. After the dissolution of the precipitate and the reduction of the quadrivalent cerium to the tervalent state, thorium can be determined photometrically with Arsenazo I. The results of analysis of several samples by this method agree with those of the controls. (auth)

34131 DETERMINING COFFEE-BEAN MOISTURE CONTENT BY THE NEUTRON-SCATTERING METHOD. Wang, Jaw-Kai (Univ. of Hawaii, Honolulu). Trans. ASAE (Am. Soc. Agr. Engrs.), 7: 42-3(1964).

Batches of green coffee (300 lb) were steam-conditioned to incremental moisture contents of 8 to 22%. A P-19 probe with an output of 7.99×10^4 neutrons/sec was inserted into the center of the batch. The moisture was calculated from results obtained with a neutron counter. The standard deviations (%) obtained after various counting times were: after 2 min, 0.01; after 5 min, 0.005; and after 10 min, essentially zero. Bulk moisture determination by this method avoids sampling error. (Anal. Abstr., 12: (May 1965))

34132 THE MECHANISM OF THE INTERFERENCE OF OXALIC ACID IN THE CERIUM(IV)-IRON(II) TITRATION. El-Tantawi, Yehia Abdelrahman. Thesis, Philadelphia, Univ. of Pennsylvania, 1964. 118p.

A detailed kinetic study of the cerium (IV) reaction with oxalate was undertaken because of the importance of this reaction to primary standardization procedures in oxidimetry. The rate of this reaction in acid sulfate media was investigated spectrophotometrically yielding evidence in support of a mechanism involving, prior to the rate-determining oxidation-reduction step, the formation of a transient intermediate complex with properties that account for the observed variation in reaction rate with the nature and concentration of solvent anion. The overall reaction rate can be described by the expression $-\{d[Ce(SO_4)_3^-]/dt\} = [K_C K_D K_e k_3/(H^+)(HSO_4^-)][Ce(SO_4)_3^-](H_2C_2O_4)$; in which the various rate and equilibrium constants involved were experimentally evaluated. The bisulfate term typifies the complexing anion (with respect to cerium (IV)) of the medium in which the titration of iron (II) with cerium (IV) could be conducted. In the light of the rate law shown the magnitude as well as the nature of the oxalic acid interference in this titration are discussed. (Dissertation Abstr.)

34133 GAS DETECTOR FOR A GAS CHROMATOGRAPH. (to Kabushiki Kaisha Hitachi Seisakusho). British Patent 990,251. Apr. 28, 1965. Priority date Mar. 14, 1961, Japan.

A gas chromatograph detector employs an ionization chamber communicating with a discharge chamber. The gas to be tested is supplied to the ionization chamber. Helium or argon is supplied to the discharge chamber and ionized by an electric discharge. The ionized gas then passes from the discharge chamber to the ionization chamber and provides primary electrons capable of initiating ionization of the sample gas, which is detected by measuring the ionization current. (A.G.W.)

34134 APPARATUS FOR DETERMINING THE QUANTITY OF CONTAMINANT IN A SUBSTANCE. Bayly, John G.; Stevens, William H. (to Atomic Energy of Canada Ltd.). U. S. Patent 3,153,722. Oct. 20, 1964. Priority date June 1, 1960, Canada.

A method and apparatus are described for determining the quantity of contaminant in a substance by radiation absorption means. The apparatus includes a radiation source for irradiating a sample of contaminated substance, a holder for the sample, and at least three filters mounted to be presented in sequence to intercept radiation from the source after it has been transmitted by the contaminated

substance. One of the filters is adapted to absorb radiation in the region of minimum transmission, and the other two are adapted to absorb radiation symmetrically disposed in the region of minimum transmission. A detector is provided to intercept radiation from the source passing through the sample and transmitted by each of the filters respectively. Means are provided for presenting the output occasioned by one filter and the output occasioned by the two filters in opposite phases to an integrating means to obtain the integral of the opposite phase outputs. The quantity of contaminants is a function of the integrated value. The method is particularly applicable to the determination of contaminants in H_2O, D_2O, and HDO. (B.L.M.)

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Refer also to abstracts 34480, 34733, and 35608.

34135 (BM-RI-6640) HEAT OF FORMATION OF EUROPIUM SESQUIOXIDE AND EUROPIUM TRICHLORIDE. Stuve, John M. (Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center). Oct. 1964. 11p. Free(Bureau of Mines)

Provisional values for the heat of formation of europium trichloride and europium sesquioxide were determined by solution calorimetry utilizing europium metal of more than 99-percent purity. The resulting values for the heats of formation of Eu_2O_3 (cubic) and $EuCl_3$ (hexagonal) were $-386{,}970 \pm 1{,}200$ cal/mole and $-218{,}740 \pm 650$ cal/mole, respectively, measured at 298.15°K. (auth)

34136 (COO-1148-96) POLAROGRAPHIC REDUCTION OF HYDROGEN ION IN NONAQUEOUS SOLVENTS. Elving, Philip J.; Spritzer, Michael S. (Michigan Univ., Ann Arbor). [1965]. Contract AT(11-1)-1148. 32p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The polarographic reduction of hydrogen ion, furnished by dissociation of a Brønsted acid or present in the undissociated Brønsted acid, is reviewed for the situation when a solvent other than water is involved. After consideration of certain general aspects involving, inter alia, the comparison of potentials between solvents, the effects of the dielectric constant of the solvent on the observed potential and other electrochemical phenomena, and hydrogen ion reduction in aqueous solvents, the reduction of hydrogen ion is systematically considered on the basis of the nature of the solvent: (a) protonic (subdivided into hydroxylic, protogenic, and protophilic solvents) and (b) aprotic. (auth)

34137 (IS-1055) THE EQUILIBRIUM PHASE DIAGRAMS FOR THE TANTALUM-TANTALUM BROMIDE AND TANTALUM-TANTALUM IODIDE SYSTEMS. McCarley, Robert E.; Boatman, James C. (Ames Lab., Iowa State Univ. of Science and Tech.). Feb. 2, 1965. Contract W-7405-eng-42. 29p. (CONF-650401-4). Dep.(mn); $2.00(cy), 1(mn) CFSTI

From American Chemical Society, Detroit.

The tantalum–tantalum bromide and the essential features of the tantalum–tantalum iodide system were elucidated. In the bromide system four phases of composition lower than $TaBr_5$ were established, viz. $TaBr_4$, $TaBr_{2.83}$, $TaBr_{2.5}$, and $TaBr_{2.33}$. By comparison the iodide system is very simple as evidenced by only the two lower phases TaI_4 and $TaI_{2.33}$. In the bromide system, a eutectic occurs at 267° and the composition $TaBr_{4.87}$. The $TaBr_4$ melts incongruently at 392° to form liquid of composition near $TaBr_{4.85}$ and the next lower solid $TaBr_{2.83}$. Equilibrations of $TaBr_4$ at a series of temperatures above 400° established that $TaBr_{2.83}$ melts incongruently within the interval 447–453° to form bromine-rich liquid and the lower phase $TaBr_{2.5}$. Similarly, it was determined that $TaBr_{2.5}$ melts incongruently to form $TaBr_{2.33}$ in the interval 671–680°. Exact location of the melting temperatures for the bromides with Br/Ta < 4 was hindered by the very sluggish reactions. That $TaBr_{2.33}$ was the lowest phase in the system was established by equilibrations of the higher halides with tantalum at temperatures up to 750°; a melting point for $TaBr_{2.33}$ was not observed. In the iodide system the melting point of TaI_5 occurred at 382°, and a eutectic at 365° and the composition $TaI_{4.87}$. Decomposition of TaI_4 into iodine-rich liquid and $TaI_{2.33}$ occurred in the interval 395–402° at a very low rate. Equilibrations of $TaI_{2.33}$ and Ta up to 815° provided no evidence for any new phases. Both $TaBr_{2.33}$ and $TaI_{2.33}$ provide aqueous solutions of the ions $Ta_6Br_{12}^{+2}$ and $Ta_6I_{12}^{+2}$. Hence these compounds are formulated correctly as $(Ta_6Br_{12})Br_2$ and $(Ta_6I_{12})I_2$. The chemical properties and stoichiometry of the phases $TaBr_{2.5}$ and $TaBr_{2.83}$ suggest that they should be formulated as $(Ta_6Br_{12})Br_3$ and $(Ta_6Br_{12})Br_5$, respectively. (auth)

34138 (MND-3062-8) DIRECT PRECIPITATION SYNTHESIS OF STRONTIUM TITANATE. Gray, J. H., III; Samos, G. (Martin Co., Baltimore, Md. Nuclear Div.). Aug. 1964. Contract AT(30-1)-3062. 44p. Dep.(mn); $2.00(cy), 1(mn) CFSTI

A simple, efficient and safe procedure for preparation of high density, unlaminated strontium titanate pellets was accomplished using strontium titanate precipitated from an alkaline mixture of triethanolamine titanium ester (TYZOR TE) and strontium hydroxide. Of the two organic titanates tested, tetraisopropylorthotitanate and TYZOR TE, only the latter presents no fire hazard and can, therefore, be used in the hot cell. Precipitation and washing of the slurry is followed by drying and sintering the strontium titanate powder in a porous filter cup, thereby directly forming the pellet. Thus, the problem of handling dry powder and crushing sintered strontium titanate in the hot cell can be circumvented. The presence of the feed solution contaminants, 1 wt % calcium and 0.5 wt % iron, does not interfere or change any of the precipitation characteristics or properties of the directly precipitated strontium titanate. All tooling was accomplished and an amendment to the Quehanna operating license was approved in preparation for proof tests of the process with strontium-90. Unfortunately, an equipment breakdown in the designated process cell forced cancellation of these tests. Although direct precipitation appears to be a distinct improvement in the synthesis of strontium titanate, tests have not been rescheduled for the hot cell. Instead, attention has been focused on development of strontium fuel forms with a higher power density than the titanate. (auth)

34139 (N64-27740) LOW-COVERAGE HEAT OF ADSORPTION. I. ALKALI METAL ATOMS ON TUNGSTEN; ATOM-METAL INTERACTION THEORIES. Neustadter, Harold E.; Luke, Keung P. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug. 1964. 13p. (NASA-TN-D-2430) $0.50(CFSTI)

A comparison of the experimental values of heat of adsorption (in the limit of zero coverage) for sodium, rubidium, and cesium on a tungsten substrate was made with those calculated from four different atom-metal theories. The best results were obtained from the theory developed by Prosen and Sachs, which takes into account the Fermi degeneracy of the electrons in the metal. (auth)

34140 (N64-27741) LOW-COVERAGE HEAT OF ADSORPTION. II. ALKALI METAL ATOMS ON TUNGSTEN; LENNARD-JONES ATOM-ATOM INTERACTION THEORY. Neustadter, Harold E.; Luke, Keung P.; Sheahan, Thomas (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug. 1964. 22p. (NASA-TN-D-2431) $0.50(CFSTI)

A comparison of experimental values of heat of adsorption (in the limit of zero coverage) for sodium, rubidium, and cesium on a tungsten substrate was made with those calculated from an adaptation of the Lennard-Jones atom-atom interaction potential to adsorption. A new method is presented for performing the necessary summations for three specific sites on the (100) and (110) planes, and comparisons are made with existing approximation methods. (auth)

34141 (NRL-6195) AN EXPLORATORY STUDY OF RADIANT ENERGY TRANSPORT IN BeO. Chapin, E. J.;

Howe, D. G. (Naval Research Lab., Washington, D. C.). Oct. 5, 1964. 68p. $2.00(CFSTI).

Current hypotheses were reviewed relative to the contribution of radiant energy to heat transfer in BeO. Translucent thin-walled BeO tube material, heated from 1000 to 2000°C, exhibited no sustained transmission of radiant energy when exposed to radiant energy pulses of high intensity. An initial effect from the applied incident radiant energy was detected, however, which was interpreted to be due to the exposed surface of the BeO reaching a high temperature so rapidly that, momentarily, little heat was generated in the mass of the material and no immediate temperature rise occurred in the heated BeO. It was postulated that during this short interval incident radiant energy was transferred in the BeO by a process involving simultaneous emission and absorption of radiant energy in depth. A comparison was made of calculated temperature-time heating curves (based on the detected initial rates of temperature rise) with the experimental data. This comparison indicated that the temperature rise per unit of time, measured for the full duration of a pulse of radiant energy was actually less than that calculated, showing that the initial rate and therefore, the initial process of radiant energy transfer was not sustained. The transfer of radiant energy in granular fused BeO was studied simultaneously with that of the BeO tube material. The temperature effects observed in the granular material were very minor. There were no detectable effects observed in this material from the brief initial transfer of radient energy through the BeO tube. The temperature effects produced in the granular BeO were considered to result from heating the granular material by a process of absorption and reradiation of radiant energy emitted by the BeO tube and by conduction at contact points between grains. The overall results indicated that the hot BeO did not become progressively diathermanous as its temperature increased but displayed a stronger opaque behavior toward radiant energy. (P.C.H.)

34142 (NYO-2873-7) ELECTROLYTIC SOLUTIONS. Annual Progress Report. Braunstein, Jerry (Maine Univ., Orono. Dept. of Chemistry). May 31, 1965. Contract AT(30-1)-2873. 9p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Association constants of silver ion with chloride ion in molten mixtures of potassium nitrate with calcium nitrate or strontium nitrate were measured and compared with values calculated from the reciprocal coulomb effect. The results are in the direction indicated by the calculations but the experimental effect is smaller. The results with strontium are closer to the calculated values than with calcium. Association constants of silver ion with chloride and bromide (mixed ligand complexes Ag-Cl-Br) are reported in potassium nitrate and in sodium nitrate. Polarographic measurements of association constants in concentrated aqueous electrolytic solutions are shown to be consistent with previous potentiometric measurements. Potentiometric titration of concentrated aqueous solutions (0.25–1 mole H_2O/mole salt) with water in a concentration cell with silver–silver bromide electrodes indicates a weak but measurable extent of hydration of anions. (auth)

34143 (NYO-3041-1) ISOTOPE EFFECTS IN ELIMINATION REACTIONS. Final Report. Steffa, Louis J.; Pentz, Lipot; Thornton, Edward R. (Pennsylvania Univ., Philadelphia. Dept. of Chemistry). June 1965. Contract AT(30-1)-3041. 17p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

The bimolecular elimination reaction E2 of various β-phenylethyl compounds was studied at 80.5° using DO^- in D_2O and HO^- in H_2O as attacking bases. The secondary isotope effects were found to be quite high (k_D/k_H = 1.8 to 1.57), indicating a high degree of proton transfer and carbanion character in the transition states. After a review of solvent isotope effects, a study was made of acid equilibria in H_2O-D_2O mixtures. The self-ionization constant of D_2O was determined to be $K_{D_2O} = 1.379 \times 10^{-15}$. Acidic and basic dissociation constants in H_2O-D_2O mixtures were measured for 2,4-dinitrophenol, 2-nitrophenol, and imidazole. Values of K'_a (relative basicity of DO^- and HO^-) were calculated from dissociation constants of several organic acids; the best K'_a value is estimated to be 2.27, which gives an exchange constant L = 10.3. (D.L.C.)

34144 (ORNL-3658) ZONE MELTING OF INORGANIC FLUORIDES. Singh, A. J.; Ross, R. G.; Thoma, R. E. (Oak Ridge National Lab., Tenn.). July 1965. Contract W-7405-eng-26. 45p. Dep.(mn); $3.00 (cy), 1(mn) CFSTI

The segregation behavior of NaF, CaF_2, MgF_2, and MnF_2, commonly present as impurities in LiF, was investigated using zone melting techniques as a possible means of obtaining higher purity LiF for use in growing large single crystals. Experimental values obtained for the distribution coefficients of the ions, Na^+, Ca^{2+}, Mg^{2+}, and Mn^{2+} in LiF are Na^+, 0.1; Ca^{2+}, 0.1; Mg^{2+}, 0.7 to 0.8, and Mn^{2+}, 0.2 to 0.3. Zone melting techniques were also employed to study crystallization behavior of the fluoride salt mixture LiF–BeF_2–ZrF_4–UF_4 (66-28-5-1 mole %). Segregation of the uranium-bearing phase was found to be enhanced by vertical zone melting with downward passage of the molten zone, while the homogeneity of the mixture was not affected by upward passage of the zone. (auth)

34145 (TID-21101) DISPLACEMENT REACTION LIMITATIONS ON ELECTROCHEMICAL DETERMINATION OF INTERACTION PARAMETERS. Dealy, John M.; Pehlke, Robert D. (Michigan Univ., Ann Arbor). [1963]. Contract AT(11-1)-1352. 13p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Concentration cell measurements appear to offer a good means for supplying data by which the interaction parameter concept may be evaluated and utilized. Even in the absence of a current, there is an overpotential resulting from displacement reactions, which varies with time. Thus, the cell should be as close as possible to operating readiness when it is assembled so that early readings will be meaningful, and the concentration of ACl in the electrolyte should be as low as possible. Only certain components of certain alloys can be studied in concentration cells without large overvoltages due to displacement reactions. The metal whose activity is to be measured must have a free energy of formation which is more negative than those of the other metals in the alloy. This restriction is less severe for metals with higher valences. The error in the measured activity grows indefinitely as the concentration of A decreases toward zero in the alloy; thus, for a given accuracy, there is a minimum activity of A for which the method is useful. (auth)

34146 (TID-21112) A COMPARISON BETWEEN MEASURED AND CALCULATED ACTIVITY COEFFICIENTS IN MULTICOMPONENT LEAD-BASE LIQUID CONTAINING CADMIUM. Okajima, Kazuhisa; Pehlke, Robert D. (Michigan Univ., Ann Arbor). [1963]. Contract AT(11-1)-1352. 10p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

The activity of cadmium in multicomponent lead-base alloys was measured and compared with estimated activity coefficients using interaction parameters. The results of this study show that this technique is a useful and reasonably accurate means for estimating activity coefficients in dilute solutions. Since the equation on which the calculation was based is only rigorous at infinite dilution, and because the interaction parameters used in the calculation were of limited accuracy, a quantitative evaluation of this approach for this particular system was not possible. (auth)

34147 (UCRL-9987(Rev.2)) AN EXPERIMENTAL STUDY OF NON-EQUIMOLAL DIFFUSION IN TERNARY GAS MIXTURES. Getzinger, R. W.; Wilke, C. R. (Lawrence Radiation Lab., Univ. of California, Berkeley). Apr. 1964. Contract W-7405-eng-48. 15p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI

Diffusion measurements using the Stefan capillary-tube method were carried out in three ternary gas systems at 35°C. These systems comprised $CH_3OH-C_6H_6$, $CH_3OH-CCl_4$, and $C_2H_5OH-CHCl_3$ diffusing into stagnant air. The experimental results were compared with calculations from the Stefan-Maxwell equations. (D.L.C.)

34148 (UCRL-11979) LOW-LYING ENERGY STATES IN NINE-VALENCE-ELECTRON DIATOMIC MOLECULES (Thesis). Shetlar, Martin D. (Lawrence Radiation Lab., Univ. of California, Berkeley). Apr. 5, 1965. Contract W-7405-eng-48. 60p. Dep.(mn); $3.00(cy), 2(mn) CFSTI

The electronic spectra of a number of diatomic molecules with nine valence electrons were studied experimentally to determine whether unobserved low-lying energy states existed for them. The results of these experiments are correlated with previous results from the literature in an effort to clarify a number of questions pertaining to the low-lying energy states of these molecules. Problems requiring further work are pointed out. (auth)

34149 (UCRL-16019) THE KINETICS OF THE HIGH-TEMPERATURE-LOW PRESSURE TUNGSTEN-NITROUS OXIDE REACTION (thesis). De Poorter, Gerald L. (Lawrence Radiation Lab., Univ. of California, Berkeley). May 24, 1965. Contract W-7405-eng-48. 56p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

The kinetics of the tungsten–nitrous oxide reaction were studied at temperatures between 2100 and 2900°K and at gas pressures between 3×10^{-9} and 10^{-6} atm. The reaction was studied under molecular flow conditions by leaking nitrous oxide into an evacuated chamber containing an electrically heated tungsten filament. The decomposition of the nitrous oxide was followed by measuring the partial pressure of nitrous oxide, nitrogen, and molecular oxygen with a mass spectrometer connected into the system. The rate of tungsten oxidation was determined by following the change in the filament resistance as a function of time for constant temperature and pressure. On the basis of the results of other investigations, $WO_2(g)$ was assumed to be the principal oxide formed. The principal reaction is decomposition of nitrous oxide, which is unaffected by excess nitrogen but greatly reduced by excess oxygen. About one in a thousand nitrous oxide molecules that strike the surface reacts to form $WO_2(g)$ at a tungsten temperature of 2220°K and a nitrous oxide pressure of 10^{-6} atm, whereas at 2735°K and 10^{-8} atm, one in fifty nitrous oxide molecules that strike the surface is converted to $WO_2(g)$. The results of this investigation are consistent with a six-step reaction mechanism involving: (a) physical adsorption of the nitrous oxide, (b) partial evaporation of the physically adsorbed nitrous oxide, (c) decomposition of the physically adsorbed nitrous oxide molecules into nitrogen gas and chemisorbed oxygen atoms, (d) reaction of the physically adsorbed nitrous oxide molecules with chemisorbed oxygen atoms, producing molecular nitrogen and oxygen, (e) evaporation of the chemisorbed oxygen atoms, and (f) reaction of two chemisorbed oxygen atoms with the tungsten, giving $WO_2(g)$. The decomposition rate of N_2O and the rate of formation of WO_2 both increase with increasing temperature and pressure. (auth)

34150 (USNRDL-TR-847) ION-EXCHANGE PROCESSES BETWEEN IMMISCIBLE MOLTEN PHASES. Scheidt, R. C.; Freiling, E. C. (Naval Radiological Defense Lab., San Francisco, Calif.). Apr. 18, 1965. Contract AT(49-2)-1167. 14p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

To test the hypothesis that cation distribution in (alkali oxide)-(boron oxide)-(alkali halide) systems occurs by ion-exchange processes, some definitive experiments were devised and carried out. The experiments consisted of equilibrating ^{22}Na-labeled sodium borate with KCl at 830°C. Higher concentrations of K^+ than Cl^- in the borate phase and Na^+ than BO_3^- in the salt phase established the operation of cation-exchange processes in the immiscible molten system. (auth)

34151 (ORNL-tr-506) TEMPERATURE DEPENDENCE OF THE DIFFUSION COEFFICIENT OF GASES. Vyshenskaya, V. F.; Kosov, N. D. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.) from Teplo i Massoperenos, Pervoe Vses. Soveshch., Minsk, 1961, 1: 181-7(1962). 13p. Dep.(mn); $1.00(cy), 1(mn) CFSTI; $1.60(fs), $0.80(mf) JCL

Two methods (weight and freezing) for determining the diffusion coefficients of gases are described. The first method was used to determine the diffusion coefficients of the gaseous systems I_2-CO_2, CO_2-H_2, CO_2-N_2, H_2-N_2, and I_2-N_2. A semi-empirical formula for the temperature dependence is proposed, and a relationship is established between the self-diffusion coefficients and the mutual diffusion of gases. The proposed formula and the Chapman-Enskog formula both are in satisfactory agreement with the experimental data. (D.L.C.)

34152 (ORNL-tr-660) FURTHER STUDIES ON CRYSTALLINE RARE-EARTH HYDROXIDES. Fricke, R.; Duerrwaechter, W. Translated by C. B. Finch (Oak Ridge National Lab., Tenn.) from Z. anorg. Chem., 259: 305-8(1949). 5p. Dep.(mn); $1.10(fs), $0.80(mf) JCL

The existence of a crystalline oxyhydroxide of Pr was proved. The trihydroxide and oxyhydroxide of Yb were prepared. Stability curves are presented for these hydroxides. The structural data for $Yb(OH)_3$ were confirmed. An initial investigation was made of the structure of the lanthanide oxyhydroxides. An evaluation was made of the heats of formation. (auth)

34153 (ORNL-tr-661) CRYSTALLINE HYDROXIDES OF THE RARE EARTHS. Fricke, R.; Seitz, A. Translated by C. B. Finch (Oak Ridge National Lab., Tenn.) from Z. anorg. Chem., 254: 107-25(1947). 11p. Dep.(mn); $1.60(fs), $0.80(mf) JCL

Crystalline lanthanide trihydroxides can be prepared as hexagonal prisms (at least from La to Er, including Y) by heating the respective hydroxides in concentrated (7N) NaOH. Under equivalent conditions of formation, the crystals grow larger progressing to the right along the lanthanide series. The lanthanide hydroxides are soluble in concentrated NaOH, with greater solubility the higher the atomic number of the constituent lanthanide. The decomposition isobars of the trihydroxides indicate them as definite crystalline phases. Positive proof is presented for the existence of an oxyhydroxide phase of composition MeO(OH). The decomposition temperatures of the lanthanide hydroxides decrease with increasing atomic number. Considering its ionic radius, $Y(OH)_3$ has a somewhat lower decomposition temperature than the lanthanide trihydroxides. The existence of a trihydroxide and oxyhydroxide is further confirmed by x-ray studies. The trihydroxides crystallize in the hexagonal system. The values of $\underline{c}$ and $\underline{a}$ decrease with increasing lanthanide atomic number, and range from $\underline{c} = 3.55$ and $\underline{a} = 6.29$A ($c/a = 0.565$) for $La(OH)_3$ to $\underline{c} = 3.53$, $\underline{a} = 6.25$A ($c/a = 0.565$) for $Er(OH)_3$. The number of $Me(OH)_3$ molecules per unit cell is 2. (auth)

34154 CRYSTAL STRUCTURE OF STRONTIUM DISILICIDE. Janzon, K.; Schaefer, H.; Weiss, Armin (Universitaet, Heidelberg). Angew. Chem. Intern. Ed. Engl., 4: 245(Mar. 1965).

In calcium disilicide, $CaSi_2$, the Si atoms are linked together in a two-dimensionally infinite, corrugated net of hexagons. In contrast, in barium disilicide, $BaSi_2$, sodium silicide, NaSi, and potassium silicide, KSi, isolated Si_4 tetrahedra occur. In strontium disilicide, $SrSi_2$, the Si atoms form a three-dimensional framework. The shortest Si–Si distances are 2.41 Å and thus comparable with those in elemental Si (2.34 Å). The Si–Si–Si angles are 113°2′ each, i.e., very close to the angles in a regular tetrahedron. As the electronegativity of the Group II elements decreases, the shortest Si–Si distance falls off from 2.48 Å in $CaSi_2$ via 2.41 Å in $SrSi_2$ to 2.34 to 2.37 Å in $BaSi_2$. Despite the differences in the structural framework of the Si in these three compounds, each Si atom is linked directly to three neighboring Si's. Each Sr atom in $SrSi_2$ is surrounded by six Si neighbors at distances of 3.21 Å and two further Si's at 3.43 Å. Crystallographic data for $SrSi_2$ are as follows: cubic pentagonal-icosatetrahedral, space group O^8-$P4_232$, $a = 6.540 \pm 0.002$ Å; $d_m = 3.40 \pm 0.05$ g/cm³; $d_x = 3.42$ g/cm³. The unit cell contains four Sr atoms, which occupy the 4a positions, and eight Si atoms in the 8c positions of the space group with $x = 0.428$. The minimum for the dis-

crepancy index (R) is not very sharp as a function of x_{si}. Hence the parameter x cannot be given with very great accuracy. When x = 0.428, R for the series (hk0) becomes 0.10_8, for the series (hk1) 0.09_2, and for the series (hk2) 0.11_4. (BBB)

34155 FORCE CONSTANTS AND THE FORM OF NORMAL VIBRATIONS OF FORMALDEHYDE AND ITS DEUTERIUM-SUBSTITUTED. Budzinski, J. (Coll. of Agriculture, Szczecin, Poland). Bull. Acad. Polon. Sci., Ser. Sci. Math. Astron. Phys., 13: 183-7(1965).

In calculating the force constants for H_2CO and D_2CO use was made of the model of valency forces. Nine force constants of planar vibrations were introduced to take into account all interactions of independent coordinates; one force constant of non-planar vibrations was also introduced. The possibility of making allowance for the anharmonicity by introducing the so-called anharmonic constant was also studied. The frequencies calculated by the medium of this constant were then compared with those obtained by introduction of the spectroscopic mass. The results are discussed. (P.C.H.)

34156 CHEMISTRY OF THE COMPLEXES OF URANYL AND PLUTONYL IONS WITH ORGANIC LIGANDS. Balakrishan, P. V.; Patil, S. K.; Sharman, H. D.; Venkatasetty, H. V. (Atomic Energy Establishment, Trombay, India). Can. J. Chem., 43: 2052-8(July 1965).

A series of complexes of uranyl and plutonyl ions with different organic ligands were prepared and investigated by infrared spectra and magnetic susceptibility measurements. The uranyl complexes were found to be weakly diamagnetic and the plutonyl complex was found to be paramagnetic. Two ligand series are defined on the basis of the infrared asymmetric stretching frequency of the uranyl and plutonyl groups. (auth)

34157 THE PREPARATION OF ANHYDROUS ZIRCONIUM DICHLORIDE. Swaroop, B.; Flengas, S. N. (Univ. of Toronto). Can. J. Chem., 43: 2115-17(July 1965).

Zirconium dichloride of a purity between 95 and 99% was produced by the direct reaction between zirconium trichloride powder and zirconium metal. In order to complete the reduction of zirconium trichloride, zirconium metal in excess of the stoichiometric amount was used. Possible contamination of the product was prevented by reducing the free volume of the reaction site to a minimum. X-ray data for zirconium dichloride are tabulated. (P.C.H.)

34158 NEW RARE EARTH DIORTHOSILICATE $K_3Eu(Si_2O_7)$. Bondar, I. A.; Tenisheva, T. F.; Shepelev, Yu. F.; Toropov, N. A. (Grebenshchikov Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 160: 1069-71(Feb. 11, 1965). (In Russian)

Single crystals of K and Eu diortho (pyro) silicate were synthetized by slow cooling from a molten KF solution at a rate of about 1°C per hour for 16 days. The monoaxial crystals have an index of refraction, $n_0 = 1.713$ and $n_e = 1.709$, and are weakly bifrefringent (0.004); their picnometrically determined density in kerosene is $d^{25} = 3.41$ g/cm³. The theoretical density of 3.50 g/cm³ agrees well with these data. The crystals exhibit edges of a dihexagonal prism $(11\bar{2}0)$, a hexagonal pyramid $(10\bar{1}1)$, and a pinacoid (0001). Their infrared absorption spectrum possesses bands in the 1000 to 850 and 550 to 400 cm^{-1} region and a medium intensity band at 685 cm^{-1}, which may be due to the symmetric valency oscillations of the Si–O–Si bond, indicating the presence of condensed Si–O tetrahedra and the lack of center symmetry in the Si_2O_7 ions. The unit cell parameters are $a = 9.98 \pm 0.01$ and $c = 14.44 \pm 0.02$ Å. From the data it is assumed that the crystals possess the following chemical composition: $3K_2O \cdot Eu_2O_3 \cdot 4SiO_2 = 2[K_3Eu(Si_2O_7)]$. (TTT)

34159 ON ISOTOPIC EXCHANGE REACTIONS IN KOSS'S SALTS. Grinberg, A. A.; Kuz'mina, M. A. Dokl. Akad. Nauk SSSR, 160: 1315-18(Feb. 21, 1965). (In Russian)

The chlorine isotope exchange of the above complex salts $K[Pt\ NH_3\ Cl_3]$ and $K[Pt\ Py\ Cl_3]$ (Py = pyridine) with KCl* was determined at different concentrations of the complex salt and at a varying ligand concentration. The experimental results showed that the first two-thirds of the chlorine in the complex salt exchanges rapidly, while the last one-third of the chlorine exchanges slowly. The rapid exchange is characteristic of a Cl–Pt–Cl coordination, while slow exchange is obtained with a $NH_3-Pt-Cl$ coordination. The exchange with a $Py-Pt-Cl$ coordination was even slower than that with a $NH_3-Pt-Cl$ coordination. These data were in good agreement with the fact that the trans effect of chlorine is greater than that of ammonia, and the latter is greater than the trans effect of pyridine. On the other hand, the high exchange rate of the two chlorine atoms in the $[Pt\ Py\ Cl_3]^-$ ion as compared with the $[Pt\ NH_3\ Cl_3]^-$ ion showed a greater trans effect for pyridine as compared with the trans effect of ammonia. The exchange rate was directly proportioned to the concentration of complex salt and did not depend on the concentration of KCl. The rate constants were calculated from the relation $R = kC_{complex}$ and are tabulated. (TTT)

34160 COLOR AND NONINTEGRAL VALENCE IN NIOBIUM AND TANTALUM SUBHALIDES. Robin, M. B.; Kuebler, N. A. (Bell Telephone Labs., Murray Hill, N. J.). Inorg. Chem., 4: 978-84(July 1965).

The electronic spectra of the Ta and Nb subhalide ions, $M_6X_{12}^{2+}$, were interpreted using a molecular orbital scheme involving both metal–metal and metal–ligand interactions. The only reasonable analysis followed from assuming that the Nb complexes were built on an Nb_6 framework having octahedral symmetry, whereas the corresponding Ta complexes were tetragonally elongated. This conclusion followed from the fact that certain degenerate transitions in the Nb series were split in the Ta series as would be expected for a descent in symmetry. Two-electron oxidation of the Ta complexes yielded ions having a tetragonally flattened geometry, as judged by the criterion just mentioned. (auth)

34161 PREPARATION AND PROPERTIES OF THORIUM MONOPHOSPHIDE, ThP_{1-x}, AND PHASE STUDIES OF THE PARTIAL SYSTEM Th–ThP. Gingerich, Karl A.; Wilson, Daniel W. (Pennsylvania State Univ., University Park). Inorg. Chem., 4: 987-93(July 1965).

Thorium monophosphide, ThP_{1-x}, was prepared by three methods: by direct reaction between the elements over the temperature range from 1400 to 1850°C, by thermal degradation of Th_3P_4 over the temperature range from 1100 to 2400°C, and by solid state reaction between the various combinations of thorium, Th_3P_4, and ThP_{1-x}. Chemical analysis was used for thorium and phosphorus to determine the compositions of the samples. The phase relationships in the condensed partial system Th–ThP were investigated by x ray powder diffraction and mass spectrometric techniques. The only phosphide found in this composition range was the ThP_{1-x} phase, which was coexistent with phosphorus-saturated thorium metal over the temperature range from 1000 to 2000°C. No intermediate phase could be detected. Thorium monophosphide, which crystallized in the NaCl-type structure, was found to have an existence range of $ThP_{0.96}$ to $ThP_{0.95}$ at 1000°C, with lattice parameters of 5.840 and 5.830 Å, respectively, at 26°C for the boundary composition. Within the existence range the lattice parameter appeared to be a linear function of composition. Evidence was obtained that at high temperatures the phosphorus-rich phase boundary in coexistence with Th_3P_4 shifted to a lower, and the thorium rich phase boundary to a higher, P/Th ratio. Thorium monophosphide was a blue substance with high chemical resistivity and a melting point of >2400°. (auth)

34162 INTERMEDIATES IN THE OXIDATION OF WATER BY PERXENATE. Appelman, E. H.; Anbar, M. (Argonne National Lab., Ill.). Inorg. Chem., 4: 1066-9 (July 1965).

The reactions that took place when solid sodium perxenate was dissolved in water and the solution subsequently acidified are written as follows: $Na_4XeO_6(s) + H_2O \rightarrow HXeO_6^{3-} + OH^- + 4Na^+$ and $HXeO_6^{3-} + 3H^+ \rightarrow XeO_3 + \frac{1}{2}O_2 + 2H_2O$. The product was a stable solution of hexavalent xenon. The xenon

(VI)–xenon(VIII) electrode potential was about 3v, making a number of mechanisms possible for the second reaction. Among these were processes involving the direct transfer of one or more electrons to the xenon(VIII) from one of its ligand oxygens or from a solvent water molecule. Transfer of a single electron led to the formation of an OH radical and a transient xenon(VII) intermediate, while a double electron transfer from a single donor resulted in an oxygen atom in Xe(VI). Studies indicated that the second reaction proceeds almost entirely through the formation of OH^- radicals. (F.J.H.)

34163 REACTIONS OF THORIUM CARBIDES WITH AQUEOUS SODIUM HYDROXIDE SOLUTIONS. Bradley, Mildred J.; Pattengill, Merle D.; Ferris, Leslie M. (Oak Ridge National Lab., Tenn.). Inorg. Chem., 4: 1080–2 (July 1965). (ORNL-P-621)

The reaction of thorium monocarbide with 0 to 18M NaOH at 80°C produced thorium oxide (identified by x-ray diffraction analysis) and 90 ml (STP) of gas per gram of carbide consisting of 83 vol % methane and 13% hydrogen with small quantities of C_2 to C_5 hydrocarbons. The reaction with 6M NaOH gave the same products at 40 and 80°C. The rate of reaction was not affected by the sodium hydroxide concentration. At 80°C, 95% of the gas was evolved within the first 4 hrs; the reaction was completed in 6 hrs. The reaction with 6M NaOH at 40°C was much slower, requiring about 30 hrs for 95% completion. The reaction of thorium dicarbide with 0 to 18M NaOH solutions yielded a mixture of hydrogen and gaseous hydrocarbons, a nonvolatile wax, and thorium oxide. In general the composition of the gas remained constant over the 0 to 18M NaOH concentration range except the concentration of ethyne, which increased from 8 vol % with 0 to 6M NaOH to 12% with 18M. The rate of gas evolution at 80°C in the thorium dicarbide–sodium hydroxide reaction increased with increasing base concentration. (F.J.H.)

34164 PRASEODYMIUM SESQUISELENIDE. Kalitin, V. I.; Yarembash, E. I.; Luzhnaya, N. P. Izv. Akad. Nauk SSSR, Neorgan. Materialy, 1: No. 1, 53-6(1965).

The preparation (from the elements) and the properties of pure praseodymium selenide, Pr_2Se_3, were studied. Previously praseodymium sesquiselenide was prepared by thermal dissociation of $PrSe_2$. Two methods of synthesis were explored: direct synthesis from pure elements and synthesis by a chemical transport reaction. Direct synthesis was carried out at 800 to 900°C in an evacuated and sealed quartz ampul containing a powdered mixture of the elements (Pr and Se) in a molar ratio that varied from 3:4 to 1:2. During the process of synthesis, the heating curves were recorded by differential thermal analysis (DTA). A thermal effect on the curves at 420 to 435°C indicated an exothermic reaction of the explosive type. The Pr_2Se_3 synthesis by the chemical transport reaction using iodine transport was carried out at a 10°C temperature gradient and T_2 max = 950°C. The synthesized products were iodine free. Chemical and x-ray phase analysis of the products of both reactions indicated formation of a homogeneous Pr_2Se_3 phase at a stoichiometric Pr:Se ratio or at a ratio corresponding to a slight Pr excess, and a $PrSe_2$ phase in admixture to Pr_2Se_3 at all other Pr:Se ratios within the range studied. The x-ray data confirmed the previously reported crystal structure for Pr_2Se_3, i.e., a Th_3P_4-type structure with vacancies in the cationic sublattice. The lattice constant a was determined to be 8.881 kX. The products of synthesis were polycrystalline reddish-brown substances. The Pr_2Se_3 product was stable under normal conditions but was oxidized after a longer exposure in air or on heating; it was noticeably dissociated at 1000°C in 10^{-5} mm Hg vacuum. (CFSTI)

34165 NEODYMIUM TELLURIDES. Yarembash, E. I.; Eliseev, A. A.; Zinchenko, K. A. Izv. Akad. Nauk SSSR, Neorgan. Materialy, 1: No. 1, 60-7(1965).

Polycrystalline neodymium tellurides were synthesized from the elements, and neodymium ditelluride ($NdTe_2$) single crystals were grown by the vapor transport method. Mixtures of Nd and Te in 1:1 to 1:3 molar ratios were heated in evacuated quartz ampuls. The exothermic reaction started at about 360°C. The reaction products were heat treated at a temperature in the range from 600 to 1200°C, depending on the composition of the mixtures. Chemical and x-ray phase analysis of the heat-treated products indicated formation of at least seven compounds, including the already known NdTe, Nd_3Te_4, Nd_2Te_3, and $NdTe_2$. Other compounds were identified as Nd_4Te_7, Nd_2Te_5, and $NdTe_3$. The crystal system, structural type, and lattice constants were determined for all compounds detected. Crystallographic data for three of the known compounds confirmed data from the literature, but data for Nd_2Te_3 disagreed: the Nd_2Te_3 crystal was found to be of the Th_3P_4 cubic type, identical to that of Nd_3Te_4, with a lattice constant of a = 9.421. A repeated heat treatment of the cubic Nd_2Te_3 at a higher temperature (1100°C) revealed the existence of another crystalline form of Nd_2Te_3, which was identified by a different x-ray pattern. The Nd_4Te_7 formula is subject to verification because of the analogy of structure with $NdTe_2$, as shown by the similarity of both x-ray patterns. DTA and x-ray phase analysis of a series of synthetic products containing an excess of tellurium, in respect to $NdTe_2$, made it possible to establish a tentative phase diagram for the tellurium-rich portion of the Nd–Te system, i.e., in the $NdTe_2$–Te composition region. The phase diagram showed two reversible nonvariant transformations: $NdTe_3$ into Nd_2Te_5 at 850°C and Nd_2Te_5 into $NdTe_2$ at 910°C. Ditelluride ($NdTe_2$) was more thermally stable than Nd_2Te_5 or $NdTe_3$, since it melted incongruently at over 1200°C. Single crystals of $NdTe_2$ of prismatic or pyramidal and acicular shape were grown from polycrystalline Nd_2Te_3 by chemical transport with iodine. The source was maintained at 900°C and the cooler end of the tube at 700°C. The crystals grew to various sizes up to 15 mm in length and were stable in air. Crystallographic data of the pyramidal crystals were obtained by x-ray structural analysis. All neodymium tellurides, except NdTe, were compounds of variable composition whose limits of homogeneity were narrower than in lanthanum tellurides of the same type. The polymorphism of neodymium tellurides and formation of variable composition phases were explained in terms of acceptor capacity of the unfilled d- and f-orbitals in atoms of the light rare earth elements versus the donor capacity of tellurium atoms, which are readily excitable because of their electronic configuration. (CFSTI)

34166 CALCULATION AND INTERPRETATION OF THE 129-I ISOMER SHIFTS IN THE ALKALI IODIDE LATTICES. Flygare, W. H.; Hafemeister, D. W. (Univ. of Illinois, Urbana). J. Chem. Phys., 43: 789–94(Aug. 1, 1965).

Starting with an ideal alkali halide lattice composed of closed-shell ions, the overlap and electrostatic interactions were computed between the nearest and next-nearest neighbors in the alkali iodide lattices. The electrostatic perturbation on the s electrons was found to be small relative to the overlap deformation of the free-ion wavefunctions Both effects predicted the same correct dependence for the relative isomer shifts, however. The deformed free-ion wavefunctions were used to compute the relative isomer shifts at ^{129}I in the alkali iodide lattices. The value of the nuclear parameter in ^{129}I was $\Delta R/R = 0.5 \times 10^{-4}$. (auth)

34167 HARTREE-FOCK-ROOTHAAN WAVEFUNCTIONS, POTENTIAL CURVES, AND CHARGE-DENSITY CONTOURS FOR THE HeH^+ ($X^1\Sigma^+$) AND NeH^+($X^1\Sigma^+$) MOLECULE IONS. Peyerimhoff, Sigrid (Univ. of Chicago). J. Chem. Phys., 43: 998-1010(Aug. 1, 1965).

Hartree-Fock-Roothaan wavefunctions for the ground state of the HeH^+ ion and the NeH^+ ion are reported. The potential curves for HeH^+ and NeH^+ were calculated using wavefunctions, which were optimized at the equilibrium distance and also at each internuclear distance. Their relative behavior is discussed. The Hellmann-Feynman forces on the nuclei were studied as a function of the internuclear distance with regard to the size of the basis set and optimization of the wavefunction. Spectroscopic data were calculated in different ways, a dissociation energy of 1.74 ev for HeH^+ and 2.03 ev for NeH^+ was computed, and calculations made to find the center of negative

charge for every internuclear separation. Electron-density maps were plotted for several internuclear distances in HeH^+ and for the total wavefunction and the individual molecular orbitals of NeH^+ at the equilibrium distance. (auth)

34168 GUILLEMIN-ZENER ENERGY OF H_2^+. Kim, Sungwoon; Chang, Tai Yup; Hirschfelder, J. O. (Univ. of Wisconsin, Madison). J. Chem. Phys., 43: 1092-4(Aug. 15, 1965).

The energy of the H_2^+ ground state $1s\sigma$ calculated with the Guillemin–Zener approximate wavefunction, $\psi_s = N_s \exp(-R\alpha\lambda/2)\cosh(Rb\mu/2)$, lies within 0.0005 e^2/a_0 of the exact for the full range of internuclear separations. In the limit of zero separation, $\psi_s = N_s \exp(-r_A - r_B)\cosh[(r_A - r_B)/\sqrt{3}]$. The energy still lies within 0.0010 e^2/a_0 when the additional requirement was imposed that $H\psi_s$ remained finite at the nuclei. The Guillemin–Zener energy was less accurate for the first excited $2p\sigma$ state. (auth)

34169 PERTURBATION TREATMENT OF THE GROUND STATE OF H_2^+. Lyon, William D.; Matcha, Robert L.; Sanders, William A.; Meath, William J.; Hirschfelder, Joseph O. (Univ. of Wisconsin, Madison). J. Chem. Phys., 43: 1095-1100(Aug. 15, 1965).

Rayleigh-Schrödinger perturbation calculations were carried out for the ground state of the H_2^+ molecular ion. The zero-order wavefunction for this problem was chosen to be the Guillemin and Zener variational function $\psi = N[\exp(-\alpha r_A - \beta r_B) + \exp(-\beta r_A - \alpha r_B)]$. The energies through third order and the expectation value E(1) of the Hamiltonian calculated with the wavefunction accurate through first order were computed for various choices of the parameters. For the optimum choices of both α and β, for all separations, values of E(1) were obtained, which agreed almost perfectly with the accurate series calculations of Bates, Ledsham, and Stewart. Also the values of the wavefunction accurate through the first order agreed almost perfectly at most points in configuration space with Bates et al. (auth)

34170 PARAMAGNETIC RESONANCE OF TRIVALENT ^{57}Fe IN DOUBLE NITRATE CRYSTALS. Culvahouse, J. W.; Olsen, L. C. (Univ. of Kansas, Lawrence). J. Chem. Phys., 43: 1145-9(Aug. 15, 1965).

The paramagnetic resonance absorption spectra of trivalent iron in double nitrate crystals were identified and fitted by two spin Hamiltonians, which corresponded to the two sites into which the iron enters these crystals. The two sites appeared to be the same as those occupied by trivalent chromium ions. The spin-Hamiltonian constants are reported for lanthanum zinc and cerium zinc double nitrates at temperatures of 4.2, 77, and 193°K. The hyperfine interaction constant for ^{57}Fe in either site was $(10.9 \pm 0.3) \times 10^{-4}$ cm^{-1}, which was very close to the value anticipated for a hydrated complex. (auth)

34171 LUMINESCENCE OF RARE-EARTH-ACTIVATED ZINC SULFIDE. Anderson, W. W.; Razi, S.; Walsh, D. J. (Stanford Univ., Calif.). J. Chem. Phys., 43: 1153-60(Aug. 15, 1965).

The line structure of the photoluminescence of ZnS: Tb, ZnS: Nd, ZnS: Tm, and ZnS: Dy was studied under various preparative conditions. There was a strong tendency for rare earth pairing with other lattice defects in the presence of excess S. This pairing was manifested by the appearance of new emission lines and excitation bands. Of the many distinct sites for the rare earth ion, one seemed to stand out as most important in electroluminescence, although it gave only a minor contribution to the photoluminescence. Using a variety of luminescent phenomena, at least four distinct sites for trivalent rare earth ions in ZnS could be counted and there was strong evidence that more exist. (auth)

34172 OPTICAL TRANSMISSION OF GRAPHITE COMPOUNDS. Hennig, G. R. (Argonne National Lab., Ill.). J. Chem. Phys., 43: 1201-6(Aug. 15, 1965).

Lamellar compounds of graphite are often, but not always, deeply colored. To study this color, a number of different compounds were prepared from very thin flakes cleaved from annealed single crystals. The spectral transmission of these samples was measured between 0.2 μ and either 2.2 μ or, in a few cases, 25 μ. All lamellar compounds exhibited a transmission "window" of half width about 0.2 μ, in which the absorption coefficient was three to five times lower than that of graphite. The frequency of the transmission maximum was closely proportional to the square root of the density of holes or electrons in the graphite part of the compound, suggesting that it was plasma oscillation of the excess electrons or holes, which was responsible for the transmission. The effective mass of these carriers was close to unity. In addition to these transmission maxima, a related broad absorption was observed in the far infrared. These optical measurements permitted rapid evaluation of ionization efficiencies in concentrated lamellar compounds, and facilitated kinetic studies of reaction rates and diffusion. (auth)

34173 SPECTROSCOPIC INVESTIGATION OF THE HELIUM–NEON MOLECULE. Henderson, W. R.; Matsen, F. A.; Robertson, W. W. (Univ. of Texas, Austin). J. Chem. Phys., 43: 1290-5(Aug. 15, 1965).

When a discharge was excited in a helium–neon mixture a band spectrum appeared that was absent in the spectra of the separate gases. This spectrum was attributed to the HeNe molecule. Although investigated under fairly high resolution, the spectrum was not completely analyzed. However, substitution of ^3He for ^4He resulted in isotopic shifts in agreement with those calculated for the rotational structure of a diatomic HeNe molecule. Investigation of the spatial distribution of intensity of the atomic and molecular radiation in the cathode region of a d-c discharge in a helium–neon mixture and of its behavior under a superimposed microwave field yielded an indication of the origin of the molecular spectrum. The molecular ion $HeNe^+$ was evidently formed by the reaction $He^+ + Ne + X \rightarrow HeNe^+ + X$ and then recombined partially into bound states. The molecular radiation observed was thus attributed to transitions between weakly bound states of the neutral molecule HeNe populated from above by electron–ion recombination. (auth)

34174 INFRARED ABSORPTION SPECTRA OF ISOTOPIC DIMERIC HYDROGEN CHLORIDE MOLECULES. Rank, D. H.; Glickman, W. A.; Wiggins, T. A. (Pennsylvania State Univ., University Park). J. Chem. Phys., 43: 1304-6(Aug. 15, 1965).

The spectra of HCl and of HCl mixed with DCl at 195°K were observed in the region of the HCl fundamental band. In the case of HCl three prominent lines occurred in the null gap. Smaller complex features were observed in the region extending from R(0) to P(3). The intense lines at 2891.2, 2889.8, and 2889.0 cm^{-1} had relative intensities of 1 : 0.6 : 0.1. These lines were shown to be due to the HCl dimer with a heat of formation of 2.1 kcal/mole. Treating the HCl–HCl molecule as a coupled nearly resonant system only two lines of relative intensity of 1 : 0.3 would be expected corresponding to the dimers ($H^{35}Cl-H^{35}Cl$, $H^{35}Cl-H^{37}Cl$) and ($H^{37}Cl-H^{35}Cl$, $H^{37}Cl-H^{37}Cl$) for the resolution possible with these broad features. If these were Q branches corresponding to a slightly bent dimer, the wide spread features would correspond to the other branches of the band. With the HCl–DCl mixture two additional lines were observed of separation 2.1 cm^{-1} and relative intensity 1 : 0.34. These were attributed to the dimers ($H^{35}Cl-D^{35}Cl$, $H^{35}Cl-D^{37}Cl$) and ($H^{37}Cl-D^{35}Cl$, $H^{37}Cl-D^{37}Cl$). Assuming nonresonant coupled oscillators, the measured frequencies can be computed within experimental error using a reduced mass for the molecule calculated by adding to the ^{35}Cl or ^{37}Cl the $\Delta H/D_0$ fraction of the mass of DCl, where ΔH is the heat of formation and D_0 the dissociation energy of HCl. (auth)

34175 PRESSURE-VOLUME-TEMPERATURE RELATIONS IN SOLID PARAHYDROGEN. Cook, Gerhard A.; Dwyer, Robert F.; Berwaldt, Oren E.; Nevins, Hugh E. (Union Carbide Corp., Tonawanda, N. Y.). J. Chem. Phys., 43: 1313-16(Aug. 15, 1965).

Experimental data are presented for the molar volume of solid parahydrogen at five different temperatures over the

range 11.49 to 19.97°K and at pressures from 0 to 350 atm. In making the density measurements, it was found that there is a fairly well-defined region of temperature and pressure in which solid hydrogen is viscoelastic. At higher pressures the solid was rather hard and rigid. A diagram is presented to give an idea of the PVT relations for solid parahydrogen up to a pressure of about 400 atm. The accuracy with which the points on this diagram are known ranges from ±0.2% along the melting line to ±5% at points far from the melting line. The shape of the isobars in the neighborhood of the melting line was observed; at pressures about 150 atm, each isobar passed through a maximum at a molar volume, which was greater than the corresponding molar volume along the melting line. It appeared that the thermal coefficient of expansion of solid parahydrogen is negative in a narrow range of temperature and pressure. (auth)

34176 NEW MODEL FOR CLASSICAL FLUIDS. [PART] I. Wertheim, M. S. (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 43: 1370-80(Aug. 15, 1965). (LA-DC-7119)

A simple model for classical fluids is presented. Separate guesses were made at the form of the excess entropy and the excess internal energy. The two terms were made thermodynamically consistent by a minimization of the excess Helmholtz free energy. The two boundary conditions of yielding the exact equation of state of hard spheres and yielding an exact second virial coefficient for an arbitrary potential then completely determined the model, which does not contain any adjustable parameters. The model yields a critical point and van der Waals loops at subcritical temperatures for any potential containing an attractive region. Agreement with experimental data for argon and hydrogen was good. Some predictions of this model for a Lennard-Jones 6–12 potential were compared with real gases. (auth)

34177 NUCLEAR SPIN-SPIN INTERACTIONS. V. ^{1}H-^{14}N SPIN-SPIN COUPLING AND QUADRUPOLAR RELAXATION IN QUATERNARY AMMONIUM SALTS. Lehn, Jean-Marie; Franck-Neumann, Michel (Institut de Chimie, Strasbourg). J. Chem. Phys., 43: 1421-2(Aug. 15, 1965).

Line shapes in nuclear magnetic resonance spectra are determined by the quadrupolar coupling constant between the nuclear electric quadrupole and the electric-field gradient at the nucleus. This field gradient depends on the structure and conformation of the molecule studied. Quadrupolar relaxation studies were made of the ^{14}N nucleus in quaternary ammonium salts. In these compounds a stepwise variation of the internal field gradient at a given ^{14}N nucleus was possible by changing the chain length. When the chain length decreased, the quadrupolar relaxation of the ^{14}N nucleus became more effective, broadened the ^{14}N resonance line, and destroyed progressivly the $^{14}N-C^{1}H_3$ spin–spin coupling. (F.J.H.)

34178 ROTATING DISK STUDY OF THE DISSOLUTION OF ZIRCONIUM IN HF–HNO_3. Meyer, R. E. (Oak Ridge National Lab., Tenn.). J. Electrochem. Soc., 112: 684-8 (July 1965).

The rotating disk electrode system was used to determine the rate constants of the reaction of zirconium with HF in solutions of HNO_3 and HF. The reaction was found to be first order with respect to HF, and the rate constants decreased slightly as the potential became more anodic. Possible mechanisms explaining the role of HF in the dissolution reaction are discussed. (auth)

34179 HYDROGEN OVERVOLTAGE ON RHENIUM AND NIOBIUM ELECTRODES. Joncich, M. J. (Univ. of Tennessee, Knoxville); Stewart, L. S.; Posey, F. A. J. Electrochem. Soc., 112: 717-21(July 1965).

Polarization curves of the hydrogen evolution reaction are presented for rhenium and niobium electrodes in dilute hydrochloric acid solutions as a function of temperature. The Tafel reaction was the rate-determining step in the hydrogen evolution reaction on rhenium. The behavior of niobium electrodes was much more complicated. The presence of the passive oxide layer on niobium produced an ohmic contribution to the total overvoltage. The corrected activation-overvoltage curves for niobium showed a change of Tafel slope, which was consistent with a Volmer-Tafel mechanism if certain assumptions were made about the distribution of potential at the interface. Activation energies of the hydrogen reaction were computed for both rhenium and niobium electrodes. (auth)

34180 EFFECT OF CONCENTRATION ON THE FLUORESCENCE OF SAMARIUM IN CERIUM DIOXIDE. Kestigan, Michael; Curry, Ronald H.; Leipziger, Fredric D. (Sperry Rand Research Center, Sudbury, Mass.). J. Electrochem. Soc., 112: 746-7(July 1965).

Spectrographic studies indicated that four peaks were present in the fluorescence spectra of samarium-activated cerium dioxide. These were located at 573, 607, 615, and 621 mμ. Only the 573 and 615 mμ peaks were strong enough to be studied quantitatively. This fluorescence (573 mμ) was observed at concentrations as low as 10^{-4} mole % Sm_2O_3. A plot of fluorescence intensity versus concentration is shown. The fluorescence intensity showed a slow increase with increased samarium oxide concentration to a broad maximum at about 0.01 mole % followed by a decrease to a concentration of about 10 mole % Sm_2O_3. The fluorescence was not detectable at concentrations above 10 mole % Sm_2O_3. These samples were all found to be contaminated with other rare earths in concentrations ranging from 0.05 to 100 ppm. Samarium was present as an impurity in all cerium dioxide samples that exhibited the fluorescence. The level of samarium ranged from 5 to 50 ppm ± 50%. (F.J.H.)

34181 THEORETICAL ELECTROMOTIVE FORCES FOR CELLS CONTAINING A SINGLE SOLID OR MOLTEN FLUORIDE, BROMIDE, OR IODIDE. Hamer, Walter J.; Malmberg, Marjorie S.; Rubin Bernard (National Bureau of Standards, Washington, D. C.). J. Electrochem. Soc., 112: 750-5(July 1965).

An emf series is given for solid and molten fluorides, bromides, and iodides. Since for these solid and molten systems at high temperatures, bromide and iodine exist as gases, the data for the aqueous system in these cases are for the gaseous state even though the stable state at this temperature (25°C) is liquid and solid, respectively. The emf's for liquid bromine and solid iodine for aqueous systems at 25°C would be 0.016 v and 0.100 v lower than those given in the tables. In each case it may be noted that the order of the elements does not parallel that of the aqueous system. The orders for the solid and molten fluorides, chlorides, bromides, and iodides were not the same. There was not a constant difference between any two halide series. (F.J.H.)

34182 MASS SPECTROMETRIC INVESTIGATION OF BARIUM IODIDE AND CAESIUM IODIDE VAPORIZATIONS. Winchell, Perrin (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nature, 206: 1252(June 19, 1965).

The experimental arrangement used is described. With Ag present in barium iodide, major ions in order of importance were BaI^+, BaI_2^+, Ag^+, Ba^+, AgI^+, and Ag_2^+. For three experiments (28 points over 1,019 – 1,278°K) the Ba^+: BaI^+: BaI_2^+ ratio was constant within 7%. It was concluded that Ba^+ and BaI^+ resulted from dissociative or fragmentary processes in the ion source and that the important vaporization was $BaI_2(l) = BaI_2(g)$. With reference to 1150°K, ΔH^0, ΔF^0, and ΔS^0 were 54 ± 4 kcal mole^{-1}, 28 ± 4 kcal mole^{-1}, and 23 ± 6 eu, respectively. For CsI, it was assumed that Cs^+ and CsI^+ resulted entirely from CsI(g) and that Cs_2I^+ resulted entirely from $Cs_2I_2(g)$. With reference to 794°K, ΔH^0, ΔF^0, and ΔS^0 for vaporization of CsI(g) from CsI(s), were 39 ± 2, 19 ± 3, and 25 ± 5. For vaporization of $Cs_2I_2(g)$ from 2CsI(s), these values were 40 ± 1, 26 ± 3, and 18 ± 4. (P.C.H.)

34183 DESORPTION OF TRITIATED BOUND-WATER FROM THE PASSIVE FILM FORMED ON STAINLESS STEELS. Okamoto, Go; Shibata, Toshio (Univ. of Hokkaido, Sapporo). Nature, 206: 1350(June 26, 1965).

The rate of desorption of the bound water in the passive film formed on stainless steel in 1N sulfuric acid at various potentials was measured using tritium as a tracer. For measurement of tritium in the form of tritiated water, a coincidence liquid-scintillation counting system was used. The amount of tritiated water desorbed from the surface film was found to increase with time according to the following empirical equation: $q = k \log t + \text{const.}$ (F.J.H.)

34184 THE FLUORESCENCE OF RARE EARTHS. I. EMISSION SPECTRA OF SAMARIUM IN PHOSPHORS BASED ON BORATE COMPOUNDS OF GROUP II ELEMENTS. Muller-Buschbaum, H.; Witzmann, H. (Universitaet, Greifswald, Ger.). Opt. Spectry. (USSR)(English Transl.), 18: 243-7(Mar. 1965).

Translated from Opt. i Spektroskopiya, 18: 432-9(Mar. 1965).

The emission spectra of samarium in borates, in eutectics of borate compounds, and also in nonstoichiometric complex calcination products with elements of the second group of the periodic system were investigated by excitation with ultraviolet light. The effect of the lattices of the primary substance on the activators was studied using the emulsion spectrum, and the results were extended to include the study of borate luminors activated with lead and thallium. (auth)

34185 ON THE LUMINESCENCE AND ABSORPTION OF TRIVALENT NEODYMIUM IN CRYSTALS OF THE FLUORITE TYPE. Kariss, Ya. E.; Tolstoi, M. N.; Feofilov, P. P. Opt. Spectry. (USSR)(English Transl.), 18: 247-50(Mar. 1965).

Translated from Opt. i Spektroskopiya, 18: 440-5(Mar. 1965).

Absorption and luminescence spectra of single crystals of MeF_2 (Me = Ca, Sr, Ba), activated with neodymium, were investigated at 300, 77, and 4.2°K. Empirical crystal-field splitting schemes were obtained for the lowest terms of Nd^{3+} in CaF_2 (type I and II centers) and in SrF_2 (type II centers). The lifetime of the $^4F_{\frac{3}{2}}$ excited state of the neodymium ion was determined in CaF_2 (2.5 and 1.1×10^{-3} sec for type I and type II centers, respectively). (auth)

34186 PHOTON MULTIPLICATION IN CRYSTALS. I. LUMINESCENCE EXCITATION SPECTRA OF IONIC CRYSTALS IN THE REGION 4 TO 21 ev. Ilmas, E. R.; Liidya, G. G.; Lushchik, Ch. B. Opt. Spectry. (USSR) (English Transl.), 18: 255-9(Mar. 1965).

Translated from Opt. i Spektroskopiya, 18: 453-60(Mar. 1965).

The luminescence excitation spectra of eleven monocrystalline phosphors, KI(Tl), KI(In), RbI(Tl), RbI(In), CsI(Tl), CsI(In), KBr(Tl), KBr(In), KCl(Tl), KCl(In), and NaCl(Tl), were measured in the region from 4 to 21 ev. In the region of energies greater than 12 ev, the quantum yield of the luminescence of the activator increased, exceeding in many cases the value of almost unity obtained for the quantum yield of the luminescence under direct excitation of the luminescence centers. Thus, the generation of two light quanta by one exciting quantum, i.e., photon multiplication by ionic crystals in the optical region of the spectrum, was discovered. (auth)

34187 A METHOD OF CORRECTING X-RAY SPECTRA FOR NONDISPERSION-LIKE INSTRUMENTAL DISTORTIONS. Akopdzhanov, R. G.; Vainshtein, E. E. Opt. Spectry. (USSR)(English Transl.), 18: 278-81(Mar. 1965).

Translated from Opt. i Spektroskopiya, 18: 495-500(Mar. 1965).

It is shown that the instrumental function of x-ray focusing spectrographs with curved crystals does not always have a dispersion profile and is better approximated by a hyperbolic secant. By using the method of derivatives, computational formulas were developed for the correction of x-ray spectra, which were experimentally obtained under given conditions. The suggested correction procedure was tested with some model curves and was used for the correction of the K absorption spectra of copper in the metal and in the chloride. (auth)

34188 THEORY OF METALLIC BINDING. Raich, J. C.; Good, R. H. Jr., (Ames Lab., Ames, Iowa). Phys. Chem. Solids, 26: 1061-5(June 1965). (IS-945)

A model for metals, which shows physically how the binding comes about is given. For subgroup A metals the model gives a good account of the density, energy, and valence. The basic idea is to treat the conduction electrons as a gas of uniform density in a spherical shell around impenetrable spheres representing the ion cores. (auth)

34189 PARAMAGNETIC RESONANCE OF TRIVALENT SAMARIUM IONS IN CALCIUM TUNGSTATE. Kirton, J. (Royal Radar Establishment, Malvern, Worcestershire, Eng.). Phys. Letters, 16: 209-10(June 1, 1965).

Measurements of calcium tungstate doped with small amounts of samarium and sodium are presented. Measurements were made at 4.2°K and X-band microwave frequencies, and then fitted to the spin hamiltonian. (M.O.W.)

34190 THE MAGNETIC STRUCTURE OF $CoCl_2 \cdot 2D_2O$. Cox, D. E.; Frazer, B. C.; Shirane, G. (Brookhaven National Lab., Upton, N. Y.). Phys. Letters, 17: 103-4 (July 1, 1965). (BNL-9115)

The determination of the antiferromagnetic structure of $CoCl_2 \cdot 2D_2O$ at 4.2°K and zero field is described. Peaks were observed which satisfied the reflection condition corresponding to a magnetic structure in which the moment of the face-centered cobalt atom is antiparallel to that of the corner atom. Also the absence of reflection indicates that the spin direction is along the b axis. This confirms an antiferromagnetic model previously proposed. Magnetic intensities were calculated for this model with spin along the b axis. (J.F.P.)

34191 SOLUBILITY PRODUCT OF TETRAVALENT PLUTONIUM HYDROXIDE AND STUDY OF THE AMPHOTERIC CHARACTER OF HEXAVALENT PLUTONIUM HYDROXIDE. Perez-Bustamante, J. A. (Junta de Energia Nuclear, Madrid). Radiochim. Acta, 4: 67-75(June 1965).

The solubility dependence of $Pu(OH)_4$ on the pH of dilute perchloric acid solutions was studied by covering a wide interval of pH. From the experimental solubility data obtained and some theoretical implications, an attempt was made to conciliate the extrapolated, experimentally found thermodynamic solubility product with the Debye-Hückel theory on ionic effects to account for the variations in the apparent solubility product in the different experiments. The study of the apparent solubility product as a function of the ionic force indicated the existence of important discontinuities, which were tentatively explained by a number of hypothesis based on the variation of the ionic activities of the species present, and on the impurities in the precipitate used as the starting material in this work. Since analysis of the precipitate employed indicated the presence of some plutonyl hydroxide, a study of the amphoteric characteristics of this species could be undertaken simultaneously. The method used for calculation of the instability constant of the amphoteric process involved is described. A single ion-exchange experiment was carried out to obtain some information on the state of plutonium in very dilute aqueous solutions. (auth)

34192 PAPER ELECTROPHORESIS STUDY OF THE REACTION PRODUCTS OF RUTHENIUM TETRAOXIDE WITH HYDROGEN PEROXIDE. Koch, H.; Bruchertseifer, H. (Institut fuer Angewandte Radioaktivitaet, Leipzig). Radiochim. Acta, 4: 82-5(June 1965). (In German)

The action of hydrogen peroxide on acid solutions of RuO_4 resulted in Ru(III) or Ru(IV) ions. A method to characterize such ruthenic solutions by relatively simple paper electrophoresis is described. This is important for investigation of carrier-free radioactive solutions. (auth)

34193 PRODUCTION OF URANIUM, THORIUM, AND PLUTONIUM AND THEIR COMPOUNDS. Reactor Fuel Process., 8: 124-32(Spring 1965).

The decomposition of uranyl nitrate hexahydrate and studies of UO_3 hydrates are discussed. The production of UF_4 by reduction and hydrofluorination of UO_3, decomposition of $UF_4 \cdot NH_4F$, and reduction of UF_6 is reviewed. Meth-

oids for the production and the properties of uranium carbide are reviewed. Finally, production of ThO_2 powders, production of $ThCl_4$, and reduction to metal are surveyed. (D.L.C.)

34194 FACTORS INFLUENCING THE PERFORMANCE OF SOLID OXIDE ELECTROLYTES IN HIGH TEMPERATURE THERMODYNAMIC MEASUREMENTS. Steele, B. C. H.; Alcock, C. B. (Imperial Coll. of Science and Tech., London). Trans. Met. Soc. AIME, 233: 1359-67 (July 1965).

In choosing solid oxide electrolytes for use in the measurement of thermodynamic quantities at high temperatures, the two most important criteria are the values of the partial ionic and electronic conductivities. Measurements of these conductivities were made for some Group IVA oxides and solid solutions of these oxides with CaO, Y_2O_3, and La_2O_3. The total conductivities as a function of temperature, oxygen partial pressure, and composition were determined, as well as the electromotive forces of cells in which the oxygen partial pressures of the electrodes were between 10^{-7} and 10^{-25} atm at 1000°C. Additional factors that influence the experimental arrangements, such as the operating temperature, the appropriate cell atmosphere, and electrode kinetics, are also discussed. (auth)

34195 RARE EARTHS IN COVALENT SEMICONDUCTORS: THE THULIUM-GALLIUM ARSENIDE SYSTEM. Casey, Horace Craig Jr. Thesis, Stanford, Calif., Stanford Univ., 1964. 83p.

The study of impurities in semiconductors was extended to the elements of atomic numbers 57 through 71, and the Tm-GaAs system was studied in detail. Solutions containing radioactive ^{170}Tm were applied to the surface of GaAs wafers and sealed in evacuated quartz ampoules. These ampoules were heated to 800, 900, and 1000°C for times up to 100 hr. The solubilities and diffusion coefficients were obtained by fitting the experimental data with complementary error functions. The resulting surface concentration was taken as the equilibrium saturation solubility and was represented below the eutectic temperature of 1150°C by $6.7 \times 10^{25} \exp(-2.3/kT)$, which gave $C_{max} = 4 \times 10^{17}$ cm^{-3}. Diffusion was found to be faster at lower temperatures, and the diffusion coefficient D may be expressed as $2.3 \times 10^{-16} \exp(1.0/kT)$. A relation between the thermodynamic and physical properties was established in order to identify the properties that are responsible for controlling the solid-solution solubility. This relation allowed the calculation of the energy necessary to place a rare earth atom substitutionally in a Ga site of the GaAs lattice. The atom size, defined as the single-bond radius, was found to be the dominant factor in limiting the solid-solution solubility of the rare earths in GaAs. The concept of simultaneous diffusion and chemical reaction was utilized to explain the inverse temperature dependence of the Tm diffusion in GaAs. An effective diffusion coefficient was derived from Fick's laws by assuming that the impurity enters the semiconductor lattice as an interstitial atom, reacts with a vacancy, and forms an immobile substitutional atom. The resulting effective diffusion coefficient was given by $D_e = D_i (\partial C_i/\partial C)$, where D_i is the diffusion coefficient of the mobile interstitial species, and C_i and C represent the interstitial and total concentration, respectively. The partial derivative was evaluated by application of the law of mass action to the reaction of a singly ionized interstitial donor with a neutral vacancy resulting in a neutral substitutional atom and a hole. The resulting diffusion coefficient in intrinsic material is $D_e^i = D_i(C_i^+/C_s^0)$, where C_i^+/C_s^0 is the ratio of singly ionized interstitial concentration to neutral substitutional concentration. This model predicts that the diffusion in p-type material should be enhanced over its value in intrinsic material by the ratio of the hole-to-intrinsic-carrier concentration p/n_i and that it should be depressed in n-type material by the ratio of the intrinsic-carrier-to-electron concentration n_i/n. These predictions were verified experimentally to establish the validity of the proposed model. After the establishment of the diffusion model, the more rapid diffusion at lower temperatures were readily understood. The inverse temperature dependence of D may be ascribed to the more rapid change of C_s^0 with temperature than that of $D_iC_i^+$. (Dissertation Abstr.)

34196 WATER STRUCTURE AND RAMAN INTENSITIES. Wall, Theodore Thomas. Thesis, Princeton, N. J., Princeton Univ., 1964. 182p.

Raman spectra of the water stretching frequencies were obtained on solutions of KF, KCl, KBr, KI, $BeCl_2$, $MgCl_2$, $CuCl_2$, $ZnCl_2$, $SnCl_2$, $AlCl_3$, $LaCl_3$, $PrCl_3$, and $KAl(SO_4)_2$ in ordinary water and in five mole percent deuterated water. The uncoupled O–D stretching band in 5 mole % deuterated water was observed at both room and milk temperature, and the corresponding uncoupled O–H band was also recorded. No effect on the Raman spectrum of water in electrolytic solutions can be attributed directly to the cations; this was in marked contrast to the strong intensity effects and apparent frequency effects exerted by the anions. Resonance Raman behavior was absent from solutions containing colored cations (with 4358 Å excitation): Cu^{2+}, Sn^{2+}, and Pr^{3+}, where it was expected, were the low-lying cationic excited states effective as intermediate states in the Raman scattering process. The uncoupled O–H and O–D stretching bands were much more symmetrical than the stretching bands of H_2O and D_2O, and the uncoupled Raman bands were almost identical with the corresponding infrared bands. Careful examination revealed a slight asymmetry in both Raman bands, however. Changes in the Raman scattering coefficient of a substance in solution were interpreted in terms of mixing of the excited electronic states of both components of the solution. Since these excited states were the intermediate states in a perturbation treatment of the scattering process, the excited electronic states of each component were caused by the mixing to contribute to the Raman scattering coefficient of the partner. The mixing introduced new frequency terms into the expression for the scattering coefficient, and thus changed its value. By itself, the changed frequency factor accounted qualitatively, and even semi-quantitatively, for all the known features of Raman intensity behavior in solution. It also accounted for the temperature dependence of the Raman scattering of water. But, since the mixing coefficient had to be near unity in order to achieve this accounting, the perturbation treatment could be only a rough approximation, and should be replaced by a more elaborate calculation of the frequency dependence of the Raman tensor. Vibronic interaction appeared explicitly in the perturbation expression for the Raman scattering coefficient. The lack of a cation effect in aqueous solutions was then understandable, since the cationic excited states were such that no forces could be exerted on the protons. There was evidence from Raman intensities for an indirect cation effect in solutions containing polyvalent cations. This indirect effect arises from complex formation in the solution, especially if the metal-chloride interaction in the excited state was very strong. The excited state of the complex may then be preferred, i.e., of lower energy, leaving the anion excited state less available for mixing with the water molecule and hence less able to exert a Raman intensity effect. The uncoupled O–H and O–D Raman bands were replotted to give distribution functions for liquid H_2O and D_2O, using standard correlations. The distributions were smooth functions of internuclear distance, which excluded the possibility of large concentrations of gas-like or ice-like molecules in the liquid. The long distance side of these functions was not previously available. A correction was applied for the effect of hydrogen bond bending, and it was calculated that the hydrogen bonds in liquid water are, on the average, very nearly linear. No new frequencies appeared in the uncoupled spectra of any of the solutions, (in the O–D stretching region) and it was concluded that there was no vibrational distinction between water near an ion and that farther away in an aqueous solution. There could then be no condensation of the regions surrounding the ions to microcrystals of ice or salt hydrates. A large annular low pressure mercury arc lamp was constructed, and was used to excite the Raman spectra. The annular design was found to minimize the optical correlations necessary to a

determination of the true Raman scattering coefficient, if it was used in conjunction with a thin-walled sample cell. (Dissertation Abstr.)

34197 THE STANDARD HEATS OF FORMATION OF LITHIUM OXALATE, BERYLLIUM SULFATE, BERYLLIUM SULFATE DIHYDRATE, AND BERYLLIUM SULFATE TETRAHYDRATE. Letson, Billy Ben. Thesis, Tuscaloosa, Ala., Univ. of Alabama, 1964. 77p.

The design and construction of a glass-Dewar-type solution calorimeter are described. Thermistors in two opposite arms of a resistance bridge were employed to determine temperature changes. Solution calorimetry was used for determination of the standard heats of formation of lithium oxalate, beryllium sulfate, beryllium sulfate dihydrate, and beryllium sulfate tetrahydrate. The heat of formation of $Li_2C_2O_4$ was calculated by combining the heats of solution in dilute HCl of LiCl, $H_2C_2O_4$ with values from the literature for the heat of solution of hydrogen chloride and the heats of formation of LiCl, $H_2C_2O_4$, and hydrogen chloride. With diamond as the standard state of carbon the heat of formation of $Li_2C_2O_4$ is $-328,300 \pm 580$ cal/mole, and with graphite as the standard state of carbon the value is $-327,400 \pm 580$ cal/mole. The heat of formation of $BeSO_4$ was calculated by combining the heats of solution of Be metal and $BeSO_4$ in aqueous H_2SO_4 with data from the literature for the heat of formation of sulfuric acid. The heat of formation of $BeSO_4$ is $-287,560 \pm 120$ cal/mole. The heat of formation of $BeSO_4 \cdot 2H_2O$ was calculated from the heats of solution in sulfuric acid of $BeSO_4$, H_2O, and $BeSO_4 \cdot 2H_2O$ and the heats of formation of $BeSO_4$ and water. The heat of formation of $BeSO_4 \cdot 2H_2O$ is $-435,260 \pm 130$ cal/mole. The heat of formation of $BeSO_4 \cdot 4H_2O$ was calculated from the heats of solution in sulfuric acid of $BeSO_4$, H_2O, and $BeSO_4 \cdot 4H_2O$ and the heats of formation of $BeSO_4$ and water. The heat of formation of $BeSO_4 \cdot 4H_2O$ is $-578,800 \pm 130$ cal/mole. (Dissertation Abstr.)

34198 CONSTRAINED VARIATION IN QUANTUM CHEMISTRY: THE ELECTRONIC STRUCTURE OF LITHIUM HYDRIDE. Rasiel, Yecheskel. Thesis, Cleveland, Case Inst. of Tech., 1964. 72p.

A general method was developed for calculating wave functions by minimizing the energy subject to the constraints of theoretically or experimentally known moments. The method was applied to a valence-bond type configuration-interaction wave function for LiH. Only an extremely small sacrifice in energy resulted when the wave function was constrained to fit the experimental dipole moment exactly. The expectation values of other physical properties were calculated for the free-variation function and the constrained-variation function. The constrained-variation function yield improved predictions for diamagnetic shielding, diamagnetic susceptibility, and electric field gradient at the lithium nucleus. In addition, it exhibited better gauge invariance of the total susceptibility as well as improved adherence to the Hellman-Feynman condition. New predictions of other properties, which were not determined experimentally were also calculated, including the electric quadrupole moment. (Dissertation Abstr.)

34199 PROCESS FOR THE ELECTROLYTIC PRODUCTION OF URANIUM DIOXIDE CRYSTALS. (to Reactor Centrum Nederland). British Patent 922,755. May 19, 1965. Priority date Aug. 4, 1961, Netherlands.

A process is described for the electrolytic production of crystals of UO_2 in which UO_3 is reacted with hydrogen chloride gas at 500 to 600°C in a salt bath followed by dry O_2 gas to yield UO_2Cl_2. The product is electrolyzed in the same salt bath at 500 to 600°C. The salt bath must be molten at these temperatures and suitable mixtures are the eutectics of LiCl–KCl and NaCl–KCl–$MgCl_2$. The reaction is carried out in a glass container. (B.L.M.)

34200 METHOD OF INHIBITING SPONTANEOUS OXIDATION OF URANIUM DIOXIDE POWDERS. Carteret, Yvette; Chenebault, Pierre; Delmas, Roger (to Commissariat a l'Energie Atomique). British Patent 994,636. June 10, 1965. Priority date July 18, 1960, France.

A method is described for inhibiting the spontaneous oxidation of UO_2 powder that consists of contacting the UO_2 with a vaporous or non-oxidizing inhibitor that is adsorbed on the powder. The contact takes place under conditions of pressure and temperature such that the ratio of the pressure of the inhibitor at the time of adsorption to the pressure p_0 is not less than 0.05 and not more than 0.2. The p_0 corresponds to the saturation vapor pressure of a liquid inhibitor or to the pressure of liquefaction of a gaseous inhibitor both at the temperature of adsorption. The inhibitor may be CO_2, NH_3, H_2O, CCl_4, and volatile alcohols, ketones, and hydrocarbons, i.e., those alcohols, ketones, and hydrocarbons whose vapor pressure is 10 mm or more at STP. The UO_2 powder may be contacted with the inhibitor in various ways, or the inhibitor such as cracked NH_3 and H_2O vapor may be circulated in a counter-current stream through the furnace where the UO_2 is being formed so that formation and adsorption take place simultaneously. (B.L.M.)

34201 MANUFACTURE OF DENSE THORIUM OXIDE. Duncan, Larry K. (to Vitro Corp. of America). U. S. Patent 3,153,569. Oct. 20, 1964. Filed Feb. 19, 1962.

A process is described for preparing high-purity dense ThO_2 having a particle size of 1 to 5 μ. Very finely divided thorium oxalate is prepared as a starting material by rapidly adding oxalic acid to a dilute solution of $Th(NO_3)_4$ maintained at a temperature of 20°C. The finely divided oxalate is fired at a temperature of 1000–1300°F; the resultant ThO_2 particles are slurried with a wetting agent and a fluoride selected from the group NH_4F, HF, and NH_4HF_2 in which the weight ratio of fluoride ion to ThO_2 is about 4-5%; the slurry is filtered; and the wet filter cake is heated at a temperature of 1800–3200°F. (B.L.M.)

34202 PRODUCTION OF RARE EARTH CHLORIDES OF HIGH PURITY. Domning, William E.; Schechter, Dale L. (to Dow Chemical Co.). U. S. Patent 3,153,570. Oct. 20, 1964. Filed Mar. 9, 1960.

A process is described for preparing rare earth chlorides of high purity by reacting the oxide with NH_4Cl in a Ta reaction apparatus. The oxide is reacted with at least twice the stoichiometric amount of NH_4Cl. The mixture is heated to between 250 and 325°C with an inert gas passing upward through the mixture to accelerate the reaction; then the substantially reacted mixture is heated to 500 to 600°C to drive off the unreacted NH_4Cl. The crude rare earth chloride is vacuum distilled at a temperature of between 700 and 1100°C at a pressure of less than 0.1 mm of Hg to distill the chloride into a suitable trap and leave any unreacted oxide behind. (B.L.M.)

34203 PROCESS FOR PREPARING URANIUM NITRIDE. Lapat, Philip E. (to United Nuclear Corp.). U. S. Patent 3,180,702. Apr. 27, 1965. Filed Dec. 4, 1962.

Uranium nitride may be prepared by reacting finely divided U particles with nitrogen in the presence of hydrogen at a temperature between 450° and 1200°C. The partial pressure of the hydrogen is preferably 0.5-3 mm Hg, and that of the nitrogen is 150-760 mm Hg. Excess nitrogen is removed from the uranium nitride by heating in a vacuum at a temperature above 1000°C. Uranium particles of suitable size may be prepared by reacting uranium with hydrogen and decomposing the resulting uranium hydride. (A.G.W.)

34204 PREPARATION OF RARE EARTH METAL SPONGE. Schechter, Dale L.; Domning, William E. (to Dow Chemical Co.). U. S. Patent 3,186,834. June 1, 1965. Filed Mar. 2, 1961.

An apparatus and method are described for preparing rare earth sponge from rare earth metal halides by the reduction of the halide by a more active metal, alkali or alkaline earth metals. The reaction vessel is made of Ta or other substantially corrosive resistant material and is supplied with heating and filtering means. The filtering means take the form of a plate of Ta, ceramic, or other corrosion resistant material that is mounted transversely across the vessel to divide it into two parts and is pierced at numerous places with drill holes 0.01 to 0.05 in. in diam-

eter. The vessel is charged with the rare earth chloride in massive form that has been obtained by fusing the salt or by subliming it onto a cold surface. The vessel is purged of air and filled with an inert atmosphere that is maintained throughout the reaction. The amount of reductor metal that is added to the vessel is the stoichiometric amount plus 20 wt % excess. The reaction mixture is heated to a temperature somewhat above that at which the reactants and the reductor metal chloride remain molten but 30–50°C below the melting point of the rare earth metal. After the reaction is complete, the reductor metal chloride is removed by filtration; and the rare earth metal sponge is purified by heating under reduced pressure (0.001 mm Hg) to a temperature at least 50–100°C below the melting point of the metal to sublime or distill away into a trap any remaining reductor metal or rare earth metal chloride. (B.L.M.)

34205 PROCESS FOR PREPARING SOLS. Fitch, Frederick T.; Smith, Jean G. (to W. R. Grace and Co.). U. S. Patent 3,186,949. June 1, 1965. Filed Dec. 5, 1962.

A process is described for preparing actinide oxide sols, particularly urania–zirconia sols, consisting of an aqueous dispersion of particles in the 3–9 mμ size and containing up to 20% solids. A mixed solution of uranyl chloride and zirconyl chloride with a U:Zr weight ratio of about 3:1 is subjected to electrodialysis at a temperature of about 80°C in the presence of an inert atmosphere. The total metal content of the starting solution expressed as oxides is about 0.1 to 15 wt %. (B.L.M.)

Organic Chemistry

Refer also to abstracts 34143 and 35699.

34206 (UCRL-7948) PREPARATION AND STUDY OF A SERIES OF BORANE AND OCTAHYDROTRIBORATE DERIVATIVES OF METHYLATED POLYAMINES. Walker, F. E.; Pearson, R. K. (Lawrence Radiation Lab., Univ. of California, Livermore). July 2, 1964. Contract W-7405-eng-48. 11p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

A series of borane and octahydrotriborate derivatives of methylated polyamines were prepared to determine the variance in certain chemical and physical properties with increasing chain length of the basic amines and with an increase in the number of carbon atoms between adjacent nitrogen atoms. (auth)

34207 SYNTHESIS OF 1,6-BIS-(β-CHLOROETHYL-$^{14}C_1$-AMINO)-1,6-DIDEOXY-D-MANNITOL DIHYDROCHLORIDE (DEGRANOL-^{14}C). Szabolcs, Anna; Gruber, Lajos; Oetvoes, Laszlo (Central Research Inst. for Chemistry, Budapest). Acta Chim. Acad. Sci. Hung., 43: 159-60(1965).

Degranol-^{14}C(1,6-bis-(β-chloroethyl-$^{14}C_1$-amino)-1,6-dideoxy-D-monnitol dihydrochloride) labeled in the chloroethylamino groups was synthesized from 1,2-5,6-dianhydro-3,4-isopropylidene-D-mannitol and ethylene-^{14}C-imine. (auth)

34208 THE SPONTANEOUS DEGRADATION OF A TRITIATED GLYCERYL ETHER. Haigh, W. Geoffrey; Hanahan, Donald J. (Univ. of Washington, Seattle). Biochim. Biophys. Acta, 98: 640-3(June 1, 1965).

Tritium-labeled chimyl alcohol (1-O-hexadecyl glycerol) was prepared and stored in benzene at −20°C for 6 months. On examination of this material by thin-layer chromatography, most of the radioactivity was detected in compounds other than the labeled chimyl alcohol. Hydrocarbons were found to be the chief labeled breakdown product. The breakdown was mediated by use of benzene as solvent, but was retarded or eliminated by carbon tetrachloride. (M.C.G.)

34209 SYNTHESES OF 2-, 3-, AND 4-(1,8-DIHYDROXY-3,6-DISULFO-2-NAPHTHYLAZO)-MANDELIC ACIDS AS NEW REAGENTS, AND THE THORIUM COMPLEX OF THE 2-ISOMER. Toei, Kyoji; Miyata, Haruo; Mitsumata, Tadayasu (Matsushita Electric Industrial Co., Ltd., Kadoma-shi, Osaka, Japan). Bull. Chem. Soc. Japan, 38: 1050-1(June 1965).

The reagents 2-, 3-, and 4-(1,8-dihydroxy-3,6-disulfo-2-naphthylazo) mandelic acid were obtained from the corresponding diazotized amino mandelic acids which were coupled with chromotropic acid. The acid dissociation constants of the reagents were estimated spectrophotometrically. The absorption spectra of the 2-isomer solution and its thorium complex are shown. (F.J.H.)

34210 OUT-OF-PLANE POLARIZATION IN THE FLUORESCENCE EMISSION OF NAPHTHALENE-d_8 IN DURENE. Chaudhuri, N. K.; El-Sayed, M. A. (Univ. of California, Los Angeles). J. Chem. Phys., 43: 1424-6 (Aug. 15, 1965).

Polarization studies of the $C_{10}D_8$ fluorescence from the bc′, ac′, and ab faces of durene as well as from the ab and bc′ faces of biphenyl are reported. Mechanisms for out-of-plane emission are proposed. This out-of-plane transition could either be a σ,π^* (or π,σ^*) intermolecular transition (which appeared in durene because of its relatively strong crystal field) or intermolecular charge-transfer-type transition between the π system of $C_{10}D_8$ and the methyl group of durene. The hydrogen atoms of the latter group were separated from the closest carbon atom of $C_{10}D_8$ by the sum of hydrogen and carbon covalent radii. This small separation might also be effective in mixing the durene crystal states with the $C_{10}D_8$ guest states. (F.J.H.)

34211 PHOTOLUMINESCENT AND SCINTILLATION PROPERTIES OF SOME 1,3,4-OXADIAZOLE DERIVATIVES. Nagornaya, L. L.; Mnatsakanova, T. R.; Grekov, A. P.; Shvaika, O. P. Opt. Spectry. (USSR)(English Transl.), 18: 228-9(Mar. 1965).

Translated from Opt. i Spektroskopiya, 18: 403-6(Mar. 1965).

The scintillation efficiency and optical characteristics of polystyrene solutions of functionally substituted diaryl derivatives of oxadiazole having different conjugation chain lengths. The latter was varied by introducing different aromatic linkages and ethylene groups into the chain. Lengthening the conjugation chain by introducing phenyl, naphthyl, and styryl radicals into the oxadiazole molecule led to a red shift of the electronic spectra in the following order: $C_6H_5 < n-C_6H_5-C_6H_4 < C_6H_5-CH=CH < \alpha-$naphthyl. The introduction of functional substitutes in the para-positron of 2.5-diphenyl-1,3,4-oxadiazole caused a red shift of the fundamental absorption and fluorescence bands. When ortho substitutes were present, this band underwent a blue shift. (M.C.G.)

34212 SYNTHESIS OF S-(1,2-DICHLOROVINYL)-D-CYSTEINE-3-C^{14} AND S-(1,2-DICHLOROVINYL)-L-CYSTEINE-3-C^{14} AND THEIR USES WITH E. COLI B. Klubes, Philip. Thesis, Minneapolis, Univ. of Minnesota, 1962. 278p.

Work was carried out to synthesize ^{14}C-labeled S-(1,2-dichlorovinyl)-cysteine (DCVC). Model experiments with non-radioactive components showed that L-DCVC could be synthesized from formaldehyde and methyl hydrogen acetamidomalonate via DL-serine, N-chloroacetyl-DL-serine, L-serine, L-serine methyl ester hydrochloride, methyl-2-amino-3-chloro-L-propionate hydrochloride, 2-amino-3-chloro-L-propionic acid hydrochloride, and S-benzyl-L-cysteine. When these reactions were done on a small scale required to obtain a product with high specific activity no product was obtained. An alternate route of synthesis starting with formaldehyde and diethyl N-dithiocarbobenzyloxyaminomalonate via S-thiolcarbobenzyloxycysteine hydrochloride, DL-cystine, S-benzyl-DL-cysteine, N-acetyl-S-benzyl-DL-cysteine, S-benzyl-L-cysteine, plus N-acetyl-S-benzyl-D-cysteine, and S-benzyl-D-cysteine, successfully afforded D and L-DCVC on a scale suitable for synthesis of the ^{14}C-labeled products. D and L-DCVC-3-^{14}C were synthesized starting with formaldehyde-^{14}C and diethyl N-dithiocarbobenzyloxyaminomalone. Comparison of the effects of L-DCVC-3-^{14}C and ^{35}S-L-DCVC on E. coli B (a susceptible strain), in the log phase of growth, revealed that although added to the medium in the same concentration and having the same effect on the growth of the organisms, the two isotopes were not removed from the

medium to the same extent nor incorporated into cells to the same extent; the incorporation of the S isotope being greater than the of the C isotope. This indicated that DCVC becomes associated with protein by reactions other than those involving incorporation of the intact molecule, indicating that DCVC may be acting as a donor of a toxic fragment. Studies on the interaction of D-DCVC-3-^{14}C and E. coli B (susceptible strain), in the log phase of growth, demonstrated an extremely low level (0.25%) of incorporation of the total administered radioactivity. Studies on the interaction of D and L-DCVC-3-^{14}C with a resistant strain of E. coli B, in the log phase of growth, showed that the radioactivity was incorporated to an extent of less than 1%, comparable to results previously obtained with ^{35}S-L-DCVC. An attempt to purify a sample of randomly tritiated L-DCVC by means of its insoluble cupric salt, which would provide radioactive L-DCVC for radioautographic and other tracer studies, failed to give a pure product. Likewise recrystallization of the product from ethanol-water failed to give a pure product. A sample of tritiated L-cystine, approximately 95% pure, was obtained by recrystallization. Synthesis of tritiated L-DCVC from this sample of tritiated L-cystine gave a product having one-third the specific activity of the starting material (based on a half-cysteinyl residue). (Dissertation Abstr.)

34213 PROCESS FOR THE PREPARATION OF DEUTERIUM-ENRICHED AMINES. Klein, Fritz; Bar-Eli, Kedma. British Patent 994,383. June 10, 1965. Priority date Aug. 25, 1961, Israel.

A process is described for the production of deuterium enriched aliphatic amines of the general formula RR'NH where R is a hydrogen atom or an alkyl group containing 1 to 5 carbon atoms and R' is an alkyl group containing 1 to 5 carbon atoms. The amine is subjected to bithermal isotopic exchange with hydrogen in the presence of a catalyst, an alkali metal amide of the general formula MNRR' where M is an alkali metal atom and R and R' are the same as defined for the amine formula. The exchange may be effected in a range of temperatures between the freezing point and the critical temperature of the exchange agent. (B.L.M.)

34214 RADIATION-RESISTANT LUBRICANTS AND THEIR PREPARATION. (to The British Petroleum Co., Ltd.). British Patent 995,587. June 16, 1965. Filed June 14, 1963.

A method is described for preparing a lubricating oil particularly resistant to radiation for use in equipment exposed to ionizing radiation. The lubricating oil is a distillation fraction or distillation residue separated from the product obtained by reacting one molecular proportion of naphthalene with 0.8–1.2 molecular proportions of propylene tetramer in the presence of a Friedel Crafts catalyst, $AlCl_3$. The reaction is carried out in an inert solvent, and the naphthalene is mixed with the catalyst at a temperature of 80–100°C. The solution is cooled to 40–50°C for the addition of the tetramer, and then the temperature is again raised to 100°C. The lubricant has an initial boiling point of 300 or 400°C. (B.L.M.)

Radiation Chemistry

See also BIOLOGY AND MEDICINE — Radiation Effects.

Refer also to abstracts 33926, 34467, 34746, and 34749.

34215 (AD-612536) RADIATION-INDUCED SOLID PROPELLANT DECOMPOSITION. Final Technical Report. (Radiation Applications Inc., Long Island City, N. Y.). Jan. 15, 1965. Contract AF49(638)-1125. 27p. (RAI-347; AFOSR-65-0429) $2.00(CFSTI).

A study was initiated on the effects of radiation on ammonium perchlorate composite propellants. This involved the determination of the effect of radiation on the deflagration rates of binder and oxidizer separately from each other and independent of additives or other substances. In addition, the chemical products of ammonium perchlorate radiolysis were studied in detail. (CFSTI).

34216 (COO-1088-12) THE RADIATION CHEMISTRY OF HIGH POLYMERS. Technical Report No. 10, April 1, 1964–April 1, 1965. Dole, Malcolm (Northwestern Univ., Evanston, Ill.). May 1, 1965. Contract AT(11-1)-1088. 22p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

In research on the radiation chemistry of high polymers, 112 samples were irradiated using gamma radiation from ^{60}Co. The development of an ultraviolet cell for absorption spectra measurements at liquid nitrogen temperature was completed. Ultraviolet absorption spectra of irradiated polyethylene were studied. The effects of N_2O on crosslinking and chain degradation in polypropylene were determined. The distribution of vinyl unsaturation between sol and gel was calculated. Vinyl group decay in irradiated polyethylene is discussed. Electron spin resonance studies were made of irradiated isotactic polypropylene. (M.C.G.)

34217 KINETICS OF REACTIONS AND STATIONARY STATE IN A CO_2–CO–C SYSTEM IRRADIATED BY FAST ELECTRONS. Zhitneva, G. P.; Pshezhetskii, S. Ya.; Slavinskaya, N. A.; Kamenetskaya, S. A. At. Energ. (USSR), 18: 492-6(May 1965). (In Russian)

Kinetics of reactions in CO_2–CO–C system irradiated by fast (200 kev) electrons under static conditions were studied at 25 to 400°C and 200 to 600 mm Hg pressure. The absorbed energy was equal to 3.0×10^{15} ev/(cm^3 sec) at 100 μamp. The CO_2 decomposition in the presence of carbon had the zero order and the CO had the first order of magnitude. The activation energy of both reactions was close to zero. The decomposition rate of CO_2 and CO is a linear function of the radiation intensity. A fixed concentration of CO stabilized during continuous irradiation does not depend on the intensity of radiation and temperature of the reaction but depends on the magnitude of the carbon surface. (tr-auth)

34218 RADIATION DAMAGE OF ORGANIC COMPOUNDS. INVESTIGATIONS WITH THE BEAMHOLE-LOOP AT FRG. Hattenbach, K.; Melkonian, G. A.; Segler, E.; vom Baur, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Atomkernenergie, 10: 191-5(May-June 1965). (In German)

In several experimental series diphenyl was irradiated at 300, 350, and 380°C within the beamhole-loop facility at the FRG up to a content of 20% higher polyphenyls (HBR). The dose absorbed was determined by measurements of the integrated fast neutron flux with Ni-foils and measurements of the γ dose rate with a very small ionization chamber. In samples taken after certain periods of operation the yield of HBR was determined using a sublimation method and the various products of the HBR were then analyzed and identified with the help of a temperature-programmed gas chromatograph. As the HBR content increased with progressing dose nonlinearly, it became necessary to apply the differential definition $G = -dN/dE$ to calculate the G-values. They were compared with those found by others. (auth)

34219 DIFFUSION OF ETHYL METHYL KETONE IN GAMMA-RAY IRRADIATED POLYSTYRENE. Nemoto, Norio; Tanaka, Masami; Odani, Hisashi; Tamura, Mikio (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 43: 7-16(Jan. 1965).

Integral absorption and desorption of ethyl methyl ketone in gamma irradiated polystyrene were studied as a function of film thickness at a temperature below the glass transition point. For slightly-crosslinked polystyrene, the effect of sample thickness existed and the initial slopes of the reduced absorption curves increased with increasing film thickness, though the individual absorption and desorption curves appeared to have the shape expected from the purely Fickian mechanism. Values for the mutual diffusion coefficient, D, of the system were calculated using the method proposed by Odani et al. and were compared with those for untreated polystyrene. It was found that the values of D for the slightly-crosslinked polystyrene were somewhat greater than those for the untreated one in the concentration region

studied. A tentative explanation of these results is given in terms of the function of intra- and inter-molecular cross-links introduced by the gamma irradiation. For highly crosslinked polystyrene all the absorption and desorption curves were of non-Fickian type in the concentration region studied. This anomalous behavior was interpreted in terms of the model proposed by Long and Richman. (auth)

34220 THE STUDY OF ENERGY TRANSFER IN BINARY ORGANIC LIQUID MIXTURES UNDER GAMMA-IRRADIATION. Horikiri, Shozo; Saigusa, Toshifumi (Sumitomo Atomic Energy Industries, Ltd., Takarazuka, Japan). Bull. Inst. Chem. Res., Kyoto Univ., 43: 34-59(Jan. 1965).

Radioinduced light emission from various binary organic liquid mixtures, always with benzene as one component, was measured. The method used made it possible to measure the emission intensity from each component in binary mixtures. Systems studied were composed from various alkanes, alcohols, acetates, and ketones, all with benzene. Parallel measurements of the G_i value (radiolytic yields of free radicals) from the liquid mixtures were performed using diphenyl picryl hydrazyl (DPPH). There was a close correlation between the variation of the emission intensities from alkanes, alcohols, and acetates in the mixtures with benzene, and that of G_i values from the mixtures of the same compositions. In the case with a mixture of benzene and acetone there was no such correlation. This fact was explained as due to the energy transfer between the lowest excited states of the both liquids. The experimental results suggested that energy transfer processes exist between highly excited states of two components in the mixtures, and oxygen dissolved in the mixtures plays an important role in the energy transfer process. The results can also explain the fluorescent behavior of liquid scintillator systems containing two solvents. (auth)

34221 PROPERTIES OF GRAFT COPOLYMERIZED CELLULOSE FIBER. II. BUTADIENE GRAFTED COTTON AND RAYON. Tsuji, Waichiro; Imai, Masazo; Kadono, Yoriko; Ichikawa, Kimiko (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 43: 94-101(Jan. 1965).

Butadiene, butadiene-styrene, or butadiene-acrylonitrile were graft copolymerized onto cotton or rayon using high energy radiation and some properties of the grafted fibers were studied. It was found that the elasticity, heat-setting properties, abrasion resistance, and adhesion to rubber were markedly improved and the coefficient of friction of the fabric was decreased by the grafting. (auth)

34222 ELECTRON SPIN RESONANCE SPECTRA OF $S_2O_3^-$ IN IRRADIATED THIOSULFATE SINGLE CRYSTALS. Morton, J. R. (National Research Council, Ottawa). Can. J. Chem., 43: 1948-51(July 1965). (NRC-8429)

Single crystals of $Na_2S_2O_3 \cdot 5H_2O$ were irradiated and examined, at room temperature, with an esr spectrometer. Two radicals are present: the species present in highest concentration is $S_2O_3^-$; the other species has not yet been identified. (auth)

34223 HIGHLY DISPERSED ELECTROLYTIC PRECIPITATES OF CERIUM OXIDE CRYSTALS OBTAINED BY IRRADIATION. Gromov, V. V.; Kapshaninov, Yu. I. (Inst. of Physical Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 160: 1111-13(Feb. 11, 1965). (In Russian)

An attempt was made to determine the effect of ionizing radiation on the structure of electrolytic precipitates of Ce_2O_3, deposited at the cathode during the electrolysis of $CeCl_3$ solutions. The Pt anode was rotated during the process at a rate of about 120 rpm while the stainless steel cathode was stationary. The solution containing 0.02 mg/ml of Ce^{3+} was electrolyzed at a current density of 70 ma/cm^2, 12 v, pH = 2.5, and T = 55°C for 1 hour. The Ce oxide precipitated contained 80 ± 5% of the Ce^{3+} ions present in the solution. The process and the product were studied by using $^{144}CeCl_3$, with a specific activity of 19.3 mC/ml. The solution contained up to 0.3 mg/ml of Sr^{2+}, Ba^{2+}, Ca^{2+}, Al^{3+}, Fe^{3+}, and Mg^{2+} impurities, together with some ^{144}Pr. It was established that the radiation and not these impurities, was responsible for the observed effects. The electrolytic cell was exposed to a 40,000 g Ra-equivalent ^{60}Co source. The amount of the precipitate obtained was found to be independent of the radiation but its structure was affected. Increasing the absorbed dose caused the formation of a more finely dispersed precipitate. At equal absorbed doses, the radioactive isotope was found to be more effective than the external radiation. The radiation also caused radiolysis and radiochemical changes at the cathode, due to the adsorption and interaction of the products of the radiolysis of water (H^+ and OH^-). (TTT)

34224 PARAMAGNETIC RESONANCE IN L-CYSTEINE HYDROCHLORIDE IRRADIATED AT 77 deg K. Akasaka, Kazuyuki (Kyoto Univ.). J. Chem. Phys., 43: 1182-4 (Aug. 15, 1965).

An electron paramagnetic resonance study was made on a single crystal of L-cysteine hydrochloride irradiated with a 1.5-Mev electron beam at 77°K. The hyperfine structure of the main resonance pattern was found to be an almost isotropic double doublet, whereas the g factor was found to be highly anisotropic but axially symmetrical, the principal values being 2.29, 1.99, and 1.99. The main resonance was attributed to the free radical $HOOC-(NH_3Cl)CH-CH_2S$; with the unpaired electron occupying one of the two nearly degenerate orbitals of the sulfur atom. A remarkable broadening of the resonance spectrum was observed at elevated temperatures, and evidence is given that this broadening was due to a short spin–lattice relaxation time due to a large spin–orbit coupling in this free radical. (auth)

34225 ESR OF X-IRRADIATED SILVER NITRATE. Mosley, W. C.; Moulton, W. G. (Univ. of Alabama, University). J. Chem. Phys., 43: 1207-14(Aug. 15, 1965).

Four paramagnetic species were detected by ESR in single crystals of $AgNO_3$ x-irradiated at 77°K. The principal values and corresponding principal axes of the g tensors and hyperfine tensors were determined. An eight-line spectrum, four doublets, was due to Ag^{2+}. A 24-line spectrum, four sextets, was assigned to a species believed to be $AgNO_3^-$. A spectrum of four triplets characteristic of stationary NO_2 molecules was observed in previously irradiated crystals and crystals doped with $AgNO_3$. A spectrum consisting of two weak singlets was due to an unidentified species. This was the only species stable at room temperature. Discussions of the orientations, configurations, mechanisms for production, and annealing characteristics of the several species are given. (auth)

34226 PRIMARY RADICAL FORMATION IN IRRADIATED PROTEINS. Singh, B. B.; Ormerod, M. G. (Royal Military Coll. of Science, Swindon, Eng.). Nature, 206: 1314-15(June 26, 1965).

Electron spin resonance (ESR) investigations on dry proteins irradiated at room temperature showed that the stable free radicals observed are not formed at random but are localized on certain preferred sites. Mixtures of proteins and mercaptoethylamine (MEA) were made by freeze-drying from aqueous solution except in the case of zein, which was dissolved in a mixture of 70% ethanol and 30% water. The samples were irradiated in evacuated glass tubes with γ rays from 7-kC ^{60}Co source at a dose rate of 3 Mr/hr. Proteins can be divided into two classes according to their ESR spectra, observed a 77°K after irradiation at that temperature. The sulfur-containing proteins, which all gave similar spectra, were in one class. The second class contained the proteins with few or no sulfur-containing amino acids. It was also found that there was a correlation between the G values for radicals at 77°K and the sulfur content of the proteins. The higher the sulfur content the higher was the radical yield. (F.J.H.)

34227 RADIOLYTIC DEGRADATION OF AQUEOUS CYTOSINE: ENHANCEMENT BY A SECOND ORGANIC SOLUTE. Kamal, Ahmad; Garrison, Warren M. (Univ. of California, Berkeley). Nature, 206: 1315-17(June 26, 1965). (UCRL-11561)

Cytosine was chosen for investigation because the dihydrocytosine derivatives obtained on saturation of the 5,6 double bond hydrolyze readily to give the corresponding

5,6 dihydrouracil derivatives and ammonia. Sodium formate and ethanol were used as second solutes; these compounds are relatively inert toward e^-_{aq} and at the same time extremely reactive toward OH^- via $HCOO^- + OH^- \rightarrow \dot{C}OO^- + H_2O$ and $CH_3CH_2OH + OH \rightarrow CH_3\dot{C}HOH + H_2O$. The effects of added formate and ethanol on ammonia yields from the γ radiolysis of oxygen-free 0.06M solutions of cytosine at pH ~ 7 are shown. Treatment of the irradiated cytosine solutions with 0.1N hydrochloric acid for several hours prior to analysis gave $G(B'H_2) \simeq 2.4$ in good agreement with the reaction mechanism described. (F.J.H.)

34228 INTERCONVERSION OF CYSTINE AND CYSTEINE INDUCED BY X-RAYS. Dewey, D. L.; Beecher, Jean (Mount Vernon Hospital, Northwood, Middx., Eng.). Nature, 206: 1369-70(June 26, 1965).

In the presence of oxygen the radiation conversion of cysteine to cystine is very fast. Methods available for measuring SH made possible the re-examination of the radiochemical conversion of cysteine to cystine and the radiochemical conversion of cystine to cysteine. It was found that both reactions occur simultaneously, and that an equilibrium condition can be found in which the ratio of SS to SH remains unchanged. (F.J.H.)

34229 DETERMINATION OF THE POSSIBILITY OF DISCRIMINATING PARTICLES OF DIFFERENT IONIZATION DENSITY BY MEANS OF THE PULSE SHAPE IN LiI(Tl), LiI(Eu), AND CsI(In) CRYSTALS. Grudskaya, L. E.; Zakharin, Ya. A.; Tsirlin, Yu. A.; Shiran, N. V.; Shakhova, K. V. Opt. Spectry. (USSR)(English Transl.), 18: 253-4(Mar. 1965).

Translated from Opt. i Spektroskopiya, 18: 450-2(Mar. 1965).

The pulse shape of α and γ scintillation in LiI(Tl), LiI(Eu), and CsI(In) crystals was investigated to examine the possibility of separating particles with different ionization densities. The possibility of utilizing CsI(In) crystals with In concentrations up to 10^{-2} mole % for this purpose was established. (auth)

34230 PRODUCTION OF INFRARED COPPER CENTERS IN ZnS THROUGH NUCLEAR DECAY OF ^{65}Zn. Broser, I.; Franke, K.-H. (Max-Planck-Gesellschaft, Berlin). Phys. Chem. Solids, 26: 1013-20(June 1965).

Irradiation of ZnS crystals with thermal neutrons caused a certain amount of Zn atoms to decay with a half life period of 250 days to stable Cu atoms. The absorption and emission spectra of several initially pure ZnS crystals at 80°K, which were irradiated with 10^{20} thermal neutrons/cm^2 within a period of 15 days, were followed over a period of about one year. The increase of the copper concentration in the crystals with time was accompanied by a marked increase of the known infrared emission of ZnS:Cu. At the same time the 1.35 μm absorption band and the absorption in the spectral region between 0.35 to 0.8 μm also increased considerably. Both the increase of the emission intensity as well as of the absorption coefficient were found to be almost exactly a linear function of the calculated copper concentration. Assuming that the recoil energy during the decay of ^{65}Zn is too small to eject the nucleus from its place within the lattice, this demonstrated clearly that the typical infrared emission and absorption bands of ZnS:Cu are caused by copper atoms on zinc places. (auth)

34231 A HYDROGEN-CONTAINING TRAPPED HOLE CENTER IN MAGNESIUM OXIDE. Kirklin, Perry W.; Auzins, Peteris; Wertz, John E. (Univ. of Minnesota, Minneapolis). Phys. Chem. Solids, 26: 1067-74(June 1965).

Earlier ESR studies of x irradiated magnesium oxide showed the existence of centers having a positive hole trapped on an oxygen atom adjacent to a positive ion vacancy (V_1-centers). Some MgO samples showed a qualitatively similar ESR spectrum with each line a doublet. Electron-nuclear double resonance studies showed unambiguously that the splitting arises from a hydrogen atom collinear with the positive hole and the vacancy. Infrared studies of unirradiated MgO earlier showed a sharp band at 3296 cm^{-1}, which was observed to be shifted to 3323 cm^{-1} on irradiation. Decay of the 3323 cm^{-1} band occurred with corresponding growth of the 3296 cm^{-1} band and loss of the ESR signal. The 3296 cm^{-1} band was attributed to an OH^- ion with hydrogen adjacent to the vacancy. The shift occurred when a hole was trapped on an oxygen opposite the vacancy from the hydrogen atom of OH^-. The center is referred to as the V_{OH} center. (auth)

34232 DEFECT STRUCTURE OF CRYSTALLINE QUARTZ. I. RADIATION-INDUCED OPTICAL ABSORPTION. Arnold, George W. (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 139: 1234-9(Aug. 16, 1965).

Low-temperature bombardment (77°K) of synthetic crystalline quartz with fast electrons induces optical absorption (C band) near 220 mμ. For 40°C neutron irradiations the absorption maximum is near 210 mμ. The absorption has an orientation dependence when produced by electron irradiation. This dependence is exhibited by a shift in the position of maximum absorption from 220 mμ for samples cut perpendicular to the c axis (Z cut) to 217 mμ for samples cut parallel to the c axis (Y cut). The absorption in the Z-cut samples is about twice that of the Y-cut samples for equal integrated flux. In neutron-irradiated material no such dependence is noted. The defect giving rise to the C-band absorption anneals near 225°C. The electron or hole occupying the defect, however, is released below room temperature, removing the optical absorption. After heating to temperatures below 225°C, the original absorption obtained after electron irradiation at 77°K can be regained by a brief re-irradiation at 77°K (0.01 of the original integrated flux). A similar electron exposure at low temperature augments the absorption induced by fast neutrons at 40°C and introduces a strong absorption at 230 mμ which was not previously discernible. The magnitude of the C-band absorption in electron-irradiated material is strongly dependent on the crystal growth rate, increasing by a factor of about 17 for a growth rate increase of 4.5. The increase for the band produced by neutron bombardment [5×10^{17} nvt (fast)] is only about 25%. The comparison of electron irradiation and x-ray bombardments, and noncorrelation of absorption with impurity content, indicate that the defect responsible for the C-band absorption is produced by direct Coulomb encounters with lattice constituents. (auth)

34233 EFFECT OF PLASTIC DEFORMATION ON THE COLORABILITY OF "PURE" AND "DOPED" KCl CRYSTALS. Sibley, W. A.; Nelson, C. M.; Crawford, J. H., Jr. (Oak Ridge National Lab., Tenn.). Phys. Rev., 139: 1328-32(Aug. 16, 1965). (ORNL-P-895)

The effect of plastic deformation on the room-temperature production of F centers and M centers by ^{60}Co gamma rays in KCl:pure, KCl:Ca, KCl:Pb, and KCl:Sr crystals was investigated. It was found that the deformation-induced enhancement of the colorability was very sensitive to impurity type and concentration, and that there was little enhancement of the F-center concentration in the "pure" samples. The blue coloration which has been observed previously to occur at dislocation boundaries in specimens that have been deformed, irradiated, and then bleached was present in the KCl:Ca crystals but not the KCl:Pb samples. This suggests that the coloration along these boundaries is not due only to vacancy clusters produced through deformation but also depends upon certain impurities. (auth)

34234 EFFECTS ON THE SENSITIVITY OF THERMOLUMINESCENCE STIMULATED IN LiF BY γ IRRADIATION. Tournon, J. (Centre d'Etudes Nucleaires, Saclay, France). Phys. Status Solidi, 10: No. 1, K7-9(July 1, 1965). (In French)

A study of the effects on the sensitivity of thermoluminescence stimulated in lithium fluoride by gamma radiation was made by irradiating crystals of LiF at 300°K by gamma rays in a cobalt source, then exciting the crystals at 78°K with ultraviolet light. Then after reheating to 300°K a series of peaks was shown. The intensity of the light of de-excitation depended on the time of excitation of the gamma rays and of the ultraviolet light. Two curves were obtained from two gamma irradiations, the second irradia-

tion weaker than the first and showing more rapid growth. (J.F.P.)

34235 IONISATION AND IRRADIATION EFFECTS IN HIGH-VOLTAGE DIELECTRIC MATERIALS. Black, R. M.; Reynolds, E. H. (British Insulated Callender's Cables Ltd., London). Proc. Inst. Elec. Engrs., (London), 112: 1226-36(June 1965).

A study of the chemical changes produced by exposure of dielectric materials to high-energy ionizing radiation showed that the effects are similar to those involved in electrical deterioration during stress aging and when ionization has taken place in the dielectric. The principal effects observed in hydrocarbons and polymeric materials after exposure to radiation are: the crosslinking of the molecules to form an infusible gel structure; the evolution of hydrogen and low-molecular-weight fragments; molecular degradation by main-chain scission; the formation and annihilation of unsaturated groups; and, in the presence of air, processes of oxidative degradation. The corresponding electric stress and ionization phenomena are: wax or cheese formation in solid-type cables; the gas evolving characteristics of paraffinic oils; the embrittlement of insulating paper; the formation of double bonds in aged cable oils, as evidenced by increased absorption in the ultraviolet region; and the oxidation effects with air resulting in an increase in power factor. While the mechanisms of radiation-induced change are not yet completely understood, they should throw light on the corresponding electrical stress and ionization phenomena. Some of the methods used to protect organic systems against the effects of high-energy radiation are also satisfactory in reducing electrical effects, and a study of these protective mechanisms should be beneficial in the field of high-voltage dielectrics. (auth)

34236 CHAIN SCISSION AND HYDROGEN BOND BREAKAGE ON IRRADIATION OF DNA. Collyns, B.; Okada, S.; Scholes, G.; Weiss, J. J.; Wheeler, C. M. (King's Coll., Newcastle upon Tyne, Eng. and Univ. of Rochester, N. Y.). Radiation Res., 25: 526-36(July 1965).

The radioinduced chain scission of DNA molecules in various concentrations were studied by the use of phosphomonoesterase, and G values for the chain scission were estimated. The breakage of hydrogen bonds was studied by acid-induced hyperchromic effect; change of the ultraviolet absorption at the acid region was used to estimate the total destruction of the bases in the irradiated DNA. The various radiation chemical reactions of DNA molecules are summarized, and their radiobiological significance is discussed. (auth)

34237 TRANSFER OF RADIATION ENERGY TO SOLUTE MOLECULES IN IRRADIATED FROZEN AQUEOUS SOLUTIONS. Sanner, Tore (Norwegian Radium Hospital, Oslo). Radiation Res., 25: 586-600(July 1965).

The formation and stabilization of x-ray-induced solute radicals in frozen aqueous solutions of L-α-alanine, thiolated gelatin, Thiogel, and thymus DNA were studied by electron spin resonance spectroscopy. In solutions containing different solute concentrations irradiated at 77°K, the total number of radicals observed was significantly higher than the weighted average of the yields found for the pure components irradiated separately. The qualitative spectra indicated that the excess radicals stabilized in the solutions were largely solute radicals. The qualitative spectra indicated that the solute radicals formed were of the same type whether the substances were irradiated in solution or in the dry state. The presence of water was found to facilitate the secondary radical reactions occurring in the solute molecules after heat-treatment. The data indicate that in solutions a substantial indirect effect may occur even after irradiation at 77°K. The energy necessary to form a solute radical by the indirect mechanism seemed to be of the same order as that needed to form a water radical when water is irradiated at room temperature. The results indicate that the indirect effect at 77°K was largely due to the action of water radicals formed in a small sphere of bound water surrounding each solute molecule. The increasing indirect effect found with increasing irradiation temperature may be due to a greater contribution of diffusible water radicals formed outside the sphere of bound water at higher irradiation temperatures. (auth)

34238 STUDY OF THE RADIOLUMINESCENCE OF ALKALI HALIDE CRYSTALS IN THE HORIZONTAL CHANNEL OF A REACTOR. Shvarts, K. K.; Lusis, D. Yu.; Ekman, Yu. A. (Inst. of Physics, Academy of Sciences, Latvian SSR). Radiats. Fiz., No. 1, 3-13(1964).

The intensity of radioluminescence, the kinetics of the flare-up of radioluminescence, and the thermoluminescence of the crystals KCl(Tl), KBr(Tl), KI(Tl), and CsI(Tl) in the range from 300 to 600°K excited by radiation from the horizontal channel of an IRT reactor were studied. The x-ray luminescence of these crystals was also investigated. The flux used at the exit of the channel was 6×10^8 n/cm^2 · sec for thermal neutrons, 10,000 rad/hr for fast neutrons, and 7800 rad/hr for gamma rays. The thermal capacity of the reactor was 1500 kw. It was found that the contribution of thermal neutrons to the radioluminescence was negligible, and that the luminescence intensity was proportional to the total dose of fast neutrons and gamma rays. Radioluminescence and thermoluminescence differed only slightly at temperatures above room temperature, and hence the processes of energy transfer from the base substance (alkali halide) to the activator (thallium) also differed slightly under the excitation conditions studied. (CFSTI)

34239 STUDY OF THE PROCESSES OF GENERATION OF RADIATION-INDUCED DEFECTS IN IONIC CRYSTALS. Lushchik, Ch. B.; Liyd'ya, G. G.; Elango, M. A. (Inst. of Physics and Astronomy, Academy of Sciences, Estonian SSR and Inst. of Physics, Academy of Sciences, Latvian SSR). Radiats. Fiz., No. 1, 15-25(1964).

The creation of color centers in NaCl single crystals by x rays and by irradiation in the vertical channel of the IRT reactor was studied. Spectra of the creation of color centers in thin films of KI(Tl) by monochromatic ultraviolet radiation were recorded. Electron, exciton, and ionization mechanisms of the creation of color centers and radioinduced defects in ionic crystals are discussed on the basis of the data obtained and literature data. (CFSTI)

34240 THERMOLUMINESCENCE OF KCl AND KCl-Tl CRYSTALS IRRADIATED IN A REACTOR. Shvarts, K. K.; Kristapson, Ya. Zh. (Inst. of Physics, Academy of Sciences, Latvian SSR). Radiats. Fiz., No. 1, 27-33(1964).

KCl and KCl(Tl) crystals were irradiated in the vertical experimental channels of an IRT reactor in the immediate vicinity of the active zone with a thermal neutron flux of 6×10^{12} n/cm^2 · sec, a fast neutron flux of approximately 10^{12} n/cm^2 · sec, and gamma radiation of about 6000 R/sec. The thermoluminescence was investigated in the range from 300 to 600°K and recorded using a unit consisting of a photomultiplier, a d-c amplifier, and a potentiometer. It was found that irradiation of the crystals creates deep capture levels ($T_{max} \approx 554$°K), which are manifest by additional absorption in the ultraviolet and indicate major lattice disturbances. Spectra of additional absorption of KCl and KCl(Tl) differ from luminescence, and depend on the thallium concentration, flux intensity (n/cm^2 sec), and integral flux (n/cm^2) of the reactor radiation. Radioluminescence induced by neutrons was observed in all the crystals. The capture centers created in the crystals by small integrated fluxes of reactor radiation at room temperature did not differ from those produced by x rays and gamma rays. (CFSTI)

34241 STUDY OF RADIATION-INDUCED CREATION AND ANNEALING OF VACANCIES IN IONIC CRYSTALS BY MEANS OF THE REFERENCE COLORATION METHOD. Elango, M. A. (Inst. of Physics and Astronomy, Academy of Sciences, Estonian SSR). Radiats. Fiz., No. 1, 35-45 (1964).

The reference coloration method, a technique for studying the quantity of point defects in a crystal, involves absorption measurements following brief irradiation of the crystal and is based on the fact that the intensity of

the band in the absorption spectrum of the crystal is proportional to the number of color centers responsible for this band. The method and its possible applications to the study of radioinduced creation and annealing of vacancies in ionic crystals are discussed. An investigation was made into the creation of radiation defects in NaCl single crystals irradiated in an IRT reactor and by x rays, and into their annealing under nonisothermal conditions. It is shown that annealing of anionic vacancies occurs at a higher temperature than the thermal destruction of F-centers. The examples given show the promise of the method in studies of physical processes in ionic crystals exposed to ionizing radiations. (CFSTI)

34242 PHOTOSTIMULATED EMISSION FROM COLORED NaCl AND KCl CRYSTALS. Belkind, A. I.; Nagli, L. E. (Inst. of Physics, Academy of Sciences, Latvian SSR). Radiats. Fiz., No. 1, 51-68(1964).

The influence of ultraviolet and x rays on the spectrum of photostimulated emission from natural and artificial NaCl and KCl single crystals was investigated. The crystals were colored by the undecomposed light of an aluminum spark or by x rays from a tube with a copper anticathode (55 kv, 10 ma). The study showed that photostimulated electron emission (PSE) in the region of the F absorption band is chiefly determined by the photothermoemission mechanism. The difference in the stimulation spectra was found to be related to the distribution of the density of color centers as a function of depth. This distribution determined the relative part played by the various PSE mechanisms. PSE from M color centers was observed in KCl crystals, and the influence of these centers on PSE in the region of the F-band was demonstrated. (CFSTI)

34243 EFFECT OF IONIZING RADIATION ON PHOTOSTIMULATED EMISSION FROM NaCl AND KCl CRYSTALS. Belkind, A. I.; Kalendarev, R. I. (Inst. of Physics, Academy of Sciences, Latvian SSR). Radiats. Fiz., No. 1, 69-72(1964).

An investigation was made of the growth of F-centers under the influence of ultraviolet radiation, as studied by the method of photostimulated emission (PSE). Natural NaCl and grown NaCl and KCl crystals were used. The source of ultraviolet light was a condensed aluminum spark. The process of coloration of the crystals by the spark was studied chiefly by means of the change in the PSE signal stimulated at the maximum of the F absorption band (465 mμ for NaCl and 560 mμ for KCl). The strong influence of preliminary x-irradiation followed by decolorization on the maximum value of PSE was attributed to an increase in the number of free vacancies during these two processes. The results presented show the promise of the PSE method, a phenomenon related to the properties of the surface layer of a crystal. (CFSTI)

34244 THERMAL QUENCHING OF THE X-RAY LUMINESCENCE OF SOME ALKALI HALIDE CRYSTALS. Shvarts, K. K.; Aluker, E. D.; Mezina, I. P.; Grube, M. M. (Inst. of Physics, Academy of Sciences, Latvian SSR). Radiats. Fiz., No. 1, 73-88(1964).

Studies were begun on the quenching of the luminescence of alkali halide crystals activated by mercury-like ions. The purpose of these investigations is to study quenching processes as a function of the mode of excitation (x, beta, and gamma rays and neutrons), type of activator (Tl, Pb, In, etc), and its concentration. The program also includes a study of scintillation. The temperature dependence of the intensity of steady luminescence, the flare-up of x-ray luminescence, and thermoluminescence in the range from 100 to 700°K are also studied. In order to study the effect of x-irradiation on the state of the activator, the flare-up and the excitation spectrum of the activator cross section were measured. Grown crystals of KCl(Tl), KBr(Tl), KI(Tl), and KI(In) were employed. Basic assumptions were made concerning the mechanism of the quenching of x-ray luminescence, the mechanism of transfer of energy to the activator centers, and the nature of the flare-up of luminescence. (CFSTI)

34245 SZILARD-CHALMERS REACTION OF THE TRIOXALATOCHROMIUM ION ADSORBED ON AN ANION-EXCHANGE RESIN UNDER CONTINUOUS ELUTION CONDITIONS. Matsuura, Tatsuo; Sensui, Yoshihiro; Sasaki, Takashi (Rikkyō Univ., Yokosuka, Japan). Radiochim. Acta, 4: 85-8(June 1965).

A flow method during reactor irradiation to separate the recoiling species from the parent complex ion adsorbed on an ion-exchange resin was applied to the trioxalatochromium ion. The separable yield increased as expected: 80% for the dynamic method compared with 66% for the static method, at pH 2.0 using HNO_3. The yield decreased with increasing pH with nitric or acetic acid as eluent, but the oxalic acid case showed a reverse trend. The specific activity increased with increasing pH in all cases. (auth)

34246 EFFECTS OF PROTECTION AND SENSITIVITY IN THE RADIOLYTIC DECOMPOSITION OF TRIBUTYL PHOSPHATE. Canva, Jane; Pages, Monique (Institut du Radium, Paris). Radiochim. Acta, 4: 88-91(June 1965). (In French)

The radiolytic decomposition of TBP was measured in a wide range of binary mixtures of varying concentrations in the crystalline and the liquid phase. It was found that in general in the liquid state aromatic additives act as protectors while certain saturated hydrocarbons (hexane, cyclohexane, and dodecane) sensitize the decomposition of TBP. Reasons are given for attributing these effects to transfer of ionization from TBP to the aromatic compounds and from the saturated compounds to TBP. Protection by the aromatic compounds also occurred in the solid phase, but sensitization was eliminated by freezing. Neither protection nor sensitization occurred under uv irradiation (1850 Å), which excited but did not ionize the molecules of TBP. Protection was not limited to aromatic compounds, however, since the non-aromatic cyclooctatetraene was an excellent protector, the most effective of the compounds that were studied. Cyclohexene, whose ionization potential is equal to that of benzene, also protected to a limited extent, in contrast to the behavior of saturated cyclohexane. (auth)

34247 PROTECTION EFFECT IN STYROL-ACRYLONITRILE IN THE EFFECT OF IONIZING RADIATION. Weber, Ernst J.; Heusinger, Helmut (Technische Hochschule, Munich). Radiochim. Acta, 4: 92-100(June 1965). (In German)

It was found that the action of ionizing radiation on polystyrene, polyacrylonitrile, and their copolymers produces hydrogen linearly with dose. In the polyacrylonitrile case this was in contradiction to literature data. In measurement of hydrogen emission from the copolymer, a protective effect of styrene on acrylonitrile was observed, with a maximum at small styrene contents (molar fraction 0.05). This protective effect was attributed to an energy transfer from acrylonitrile to styrene in the copolymer. This energy transfer depended on the copolymer structure; it was especially efficient when the copolymer chain contained fairly long sequences of acrylonitrile. (auth)

34248 A NEW METHOD FOR THE PREPARATION OF CARRIER-FREE PHOSPHORUS-32. Goso, R. P.; Radicella, R. (Comision Nacional de Energia Atomica, Buenos Aires). Radiochim. Acta, 4: 106-7(June 1965).

Carrier-free ^{32}P can be prepared by dissolving irradiated sulfur in carbon disulfide, followed by adsorption of ^{32}P on powered soda-lime glass. The chemical yield of the procedure was 90%. The radioactive purity of the preparation was better than 99.95% and its radiochemical purity was higher than 99.5%, after heating for 1 hr at 120°C the solution previously made 0.01N with hydrochloric acid. (F.J.H.)

34249 CYCLOHEXADIENYL-t RADICALS IN RECOIL TRITIUM REACTIONS WITH BENZENE. Garland, J. K.; Bowland, F. S. (Univ. of Missouri, Columbia and Univ. of California, Irvine). Radiochim. Acta, 4: 115-16(June 1965).

Two types of experiments were carried out: measurement of the products from reactions with gaseous benzene-cyclohexane, and determination of the fraction of the total tritium in polymeric forms from liquid-phase experiments. These data indicated the importance of the cyclohexadienyl-t

radical as a product of the hot reaction of tritium atoms in all benzene systems, and led to a consistent explanation for all the available data. The recoil tritium atoms were formed by neutron irradiation of ^3He in the gas phase, or of ^6Li-containing salts in the condensed phases. (F.J.H.)

34250 ON RADIATION-INDUCED COLORATION MECHANISMS OF IONIC CRYSTALS. Lushchik, Ch. B.; Elango, M. A. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 26, 93-111(1964). (In Russian)

A comparative investigation of F center creation processes in NaCl and NaCl(Tl) under the influence of ultraviolet radiation (6 to 12 ev) and x rays (60 kev) was carried out. The electronic, exciton, electron-hole, and ionization mechanisms of radioinduced coloration of ionic crystals are discussed. (auth)

34251 COLOR CENTERS AND RECOMBINATION LUMINESCENCE OF X-RAYED KCl–Ag, KBr–Ag AND NaCl–Ag CRYSTALS AT 100 deg K. Zolotarev, G. K. Tr. Inst. Fiz. i Astron., Akad. Nauk Est, SSR, No. 26, 121-35(1964). (In Russian)

The changes in absorption spectra, which appear in KCl(Ag), KBr(Ag), and NaCl(Ag) single crystals after being x-irradiated at 100°K, as well as different optical and thermal effects on the irradiated crystals were analyzed. The role of Ag^+ centers as effective traps for electrons and holes was investigated. Photo- and thermostimulated recombination luminescence of KCl(Ag), KBr(Ag), and NaCl(Ag) crystals appearing during recombination of electrons released from E centers and holes localized at Ag^+ centers were studied. The mechanism of recombination luminescence of ionic crystals activated with silver is discussed. (auth)

34252 PHYSICAL PROCESSES INDUCED BY IONIZING RADIATION IN ALKALI HALIDE SINGLE CRYSTALS. III. TEMPERATURE DEPENDENCE OF F-CENTERS CREATION PROCESSES INDUCED BY X-RAYS IN NaCl SINGLE CRYSTALS. Elango, M. A. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 26, 182-93(1964). (In Russian)

The temperature dependence of the creation rate of F centers by x-irradiation of NaCl single crystals was investigated. It is shown that with increasing irradiation temperature, from 100°K, the rate of F-center creation increases, goes through a maximum about 220°D, and then decreases. It was assumed that the release of anion vacancies from coagulates occurs by means of hole-ionic processes. The observed temperature dependence of the F-centers creation rate is explained by low-temperature freezing of hole processes and by high-temperature intensification of ionic processes. (auth)

34253 ON THE X-RAY COLORATION MECHANISMS OF KCl–Ag. Vale, G. K. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 28, 93-110(1964). (In Russian)

The creation of color centers in KCl(Ag) and KCl crystals by x and ultraviolet irradiation was investigated. The influence of various factors (previous irradiation, plastic deformation, excitation, density, and temperature) on center formation was examined. The E centers were created as a result of electron trapping by Ag^+ ions. Otherwise, the generation of B centers as well as F centers requires the creation of new ionic defects by the radiation. The mechanism of coloration of KCl(Ag) and KCl by irradiation is discussed. (auth)

34254 COLOR CENTERS AND RECOMBINATION LUMINESCENCE OF NaBr–Ag AND RbCl–Ag, X-RAYED AT 100°K. Zolotarev, G. K. Tr. Inst. Fiz. i Astron., Akad. Nauk Est. SSR, No. 30, 42-56(1964). (In Russian)

Spectra and relaxation processes of NaBr–Ag and RbCl–Ag crystals were examined. The mechanism of recombination luminescence and the role of self-trapping and the release of holes in photo- and thermostimulated luminescence of a homologous series of phosphors RbCl–Ag, KCl–Ag, KBr–Ag, NaCl–Ag, and NaBr–Ag are discussed. It was shown that the recombination luminescence of Ag^+ ions is due to the recombination of free electrons with localized holes (electron recombination luminescence). As a result of recombination of the free holes with localized electrons emission appears in the visible spectral region. The character of the activator color centers is discussed. (auth)

34255 IMPROVEMENTS IN OR RELATING TO ESSENTIAL OILS. Petley, Philip Theodore; Hills, Peter Robert; Roberts, Robert (to Philip Theodore Petley and United Kingdom Atomic Energy Authority). British Patent 991,411. May 5, 1965. Filed Apr. 14, 1961.

A process for the treatment of a selected essential oil consists of subjecting the oil to a dose of form ½ to 10 megarads of electron or γ radiation having a mean energy of at least 1 Mev. Specifically the process is applied to peppermint oil to improve its odor and flavor and to citrus oil to preserve it from spontaneous decomposition or resinification. Observations on effects of irradiation on other essential oils and on typical constituents of essential oils are listed. (A.G.W.)

Radiochemistry

See also Separation Processes and Procedures.

Refer also to abstract 33764.

34256 (BNWL-SA-10) BACKGROUND PROBLEMS IN THE ANALYSIS OF COUNT DATA. Nicholson, Wesley L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1964]. Contract AT(45-1)-1830. 7p. (CONF-650511-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From 20th Annual American Society Quality Control Technical Conference, Los Angeles.

The problem of random background in the interpretation of count data from radiochemical experiments is considered. Statistical methods for handling radiochemical data are discussed and criticized. Robustness of normal approximation tests are discussed. (D.L.C.)

34257 (NP-15101) ANALIZ METODA GAMMA-GAMMA-SOVPADENII, PRIMENYAEMOGO PRI ETALONIROVANII RADIOAKTIVNYKH ISTOCHNIKOV IZ KOBAL'TA-60 I NATRIYA-22. (Analysis of the Method of Gamma-Gamma Coincidences Used for Standardizing Sources of Cobalt-60 and Sodium-22). Report No. 114. Garapov, E. F.; Gryaznov, Yu. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR). [1964]. 11p. Dep.(mn).

A method of coincidences was used for measuring radioactivity from ^{60}Co and ^{22}Na sources decaying with two-gamma quanta cascade or with positron branch with subsequent gamma quanta emission. A block of γ quanta detectors (photomultipliers with 40 × 40 mm NaI(Tl) crystals) installed at 125° angle at 100 mm from the source were used for simultaneous recording of one decay event with two-gamma quanta and their coincidences. The activity was determined by the count rate and the rate of coincidences. Corrections were made for various energy gamma quanta in each channel, for angular correlations, detector and source finite geometric dimensions, and for dead time of the apparatuses. The number of decays in the source per unit of time was calculated. (R.V.J.)

34258 (NP-15102) IDENTIFIKATSIYA I IZMERENIE AKTIVNOSTI DOLGOZHIVUSHCHIKH OSKOLOCHNYKH BETA-AKTIVIYKH IZOTOPOV, VKHODYASHCHIKH V SOSTAV DISPERSNOI FAZY AEROZOLEI. (Identification and Measurement of the Activity of Long-Lived Beta-Active Isotope Fission Fragments in the Dispersion Phase of Aerosols). Report No. 118. Bolotin, V. F.; Nemilov, N. F. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR). [1964]. 13p. Dep.(mn).

Radiometric analysis was made of beta active fragments (^{137}Cs, ^{90}Sr, ^{90}Y, ^{106}Ru, ^{106}Rh, ^{144}Ce, ^{144}Pr, ^{95}Zr, and ^{95}Nb) simultaneously present in the air of radiochemical plants. The identification and measurements were carried out with an air-collector with filter belt and β- and γ-spectrometer transducers erected on one stand and an electron-measuring equipment consisting of seven identical differential discriminators regulated by the channel width and

seven identical numerical counters on another stand. The sensitivity of the installation is about 1×10^{-13} c/l in cases in which the content of all isotopes is identical. (R.V.J.)

34259 (NP-15104) RADIOMETRIYA IODA. (Radiometry of Iodine). Report No. 109. Artemenkova, L. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR). [1964]. 8p. Dep.(mn).

A brief review is given of the methods and equipment used in radiometry of radioactive iodine released during treatment of nuclear fuel and in laboratories producing radioactive isotopes. (R.V.J.)

34260 (RFP-538) OBSERVATIONS OF GAMMA EMISSIONS ASSOCIATED WITH THORIUM REMOVAL FROM A U^{233} SAMPLE. Kirchner, R. A.; Freiberg, K. J. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). June 16, 1965. Contract AT(29-1)-1106. 19p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

The gamma hazard from ^{233}U in ^{233}U produced by neutron activation of natural Th is discussed. It is shown that a significant reduction in gamma levels can be attained by removal of ^{228}Th. Chemical processes were carried out on $2\frac{1}{2}$-year-old ^{233}U oxide samples to separate Th, and the resulting green salt was reduced to a ^{233}U metal button. The gamma activity at the various stages in the processing and reduction was measured, and the optimum times for carrying out the processes are discussed. (D.L.C.)

34261 SPECTRUM OF BREMSSTRAHLUNG AND CHARACTERISTICAL RADIATION EMITTED BY ZIRCONIUM–TRITIUM SOURCE. Betin, Yu. P. At. Energ. (USSR), 18: 516-18(May 1965). (In Russian)

The spectral composition of a zirconium-tritium source radiation was measured using a sealed proportional soft x-ray counter with a 20μ Terylene side window and 1.5 mm wide and 20 mm long front window opening. The counter was filled with an argon and isopentane mixture under 600 mm Hg pressure. The pulse spectra of the counter were recorded by a 100-channel analyzer. The amplitude spectrum of proportional counter pulses measured with thick Zr–T source on a tungsten layer showed in the secondary radiation spectrum a continuous line corresponding to bremsstrahlung with maximum intensity at 6 kev and a clear line characteristic of L emission of zirconium at energy near 2.0 kev. The obtained data on electromagnetic emission from Zr–T source showed they are capable of exciting K x-ray emission from light elements starting with Al (E_k = 1.5 kev) to germanium (E_k = 9.9 kev) and heavy elements starting with niobium (E_L = 2.3 kev) to tungsten (E_L = 9 kev). (R.V.J.)

34262 UNIVERSAL SEMI-COMMERCIAL DEVICE FOR RADIATION-CHEMICAL PROCESSES USING COMPRESSED AIR FOR SHIFTING RADIOACTIVE ^{60}Co PREPARATIONS. Volgin, V. I.; Drozdov, V. E.; Eroshov, M. E.; Lisov, G. I.; Neprokin, A. N.; Ryabukhin, Yu. S. At. Energ. (USSR), 18: 546-8(May 1965). (In Russian)

Descriptions are given of a γ installation KP-140 operation with a ^{60}Co source of total activity of 200,000 g equiv. Ra. The shift of the sources, their fixation and cooling are accomplished by means of compressed air. The working chamber stores the sources and the irradiator. The installation has been in successful operation since Sept. 1964. The distribution of the piping in the working area of the installation leaves plenty of space for various apparatus. (R.V.J.)

34263 CHEMICAL DAUGHTER PRODUCTS IN THE β-DECAY OF ^{210}Bi IN TRIARYL-BISMUTH DIHALOGENIDES. Nefedov, V. D.; Vobecky, M.; Borak, J. (Leningrad State Univ. and Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Rez). Radiochim. Acta., 4: 104-6(June 1965). (In German)

Chemical daughter products of the β decay of ^{210}Bi were studied in triarylbismuth dihalogenides as a function of the halogen properties in the series from fluorine to bromine. Triarylbismuth dihalogenide and diarylpolonium halogenide were chemical forms of this nuclear transformation. The composition of daughter products of primary molecular ions depended strongly on the halogen properties of the mother substance. (auth)

34264 CORRECTION FACTOR FOR THE CALCULATION OF COUNTING RATE OF A RADIONUCLIDE. Kawashima, Toshi (Electrical Communication Lab., Tokyo). Radiochim. Acta, 4: 110(June 1965).

The counting rate at a certain moment of a radioactive sample may generally be estimated by dividing the observed number of counts by the counting period. However, if the counting period is not short compared to the half life of the radionuclide, a correction should be applied for the decay by using either the known half life or its experimentally determined value. (F.J.H.)

34265 RADIOACTIVE SAMPLE PROCESSING APPARATUS INCLUDING A CLOSED LOOP HORIZONTAL CONVEYOR SYSTEM AND AN ELEVATOR POSITIONED BENEATH THE LOOP FOR ELEVATING THE SAMPLES TO A DETECTOR. Fratantuno, Joseph (to Lab. for Electronics). U. S. Patent 3,187,182. June 1, 1965. Filed Dec. 19, 1960.

An apparatus for storing and measuring a large number of radioactive samples includes a closed, folded loop conveyor system as both the storage and principal transport means. An elevator mechanism operates in conjunction with the conveyor system to lift each individual sample into position for measurement by a detector and to return the sample to the conveyor after measurement. A discrete step-wise drive moves the flexible chain or belt to move each successive sample into the position in which the elevator operates. Since the conveyor is guided around suitably located idler wheels, a substantial length of the conveyor with a substantial number of samples may be confined in a relatively small area for storage. At the conclusion of the measurement cycle, the first sample is automatically in position for the beginning of a second cycle of measurement. A control system is provided that includes switches to indicate the presence or absence and the position of samples, to provide automatic programming, and to ensure measurement of all samples within the system in sequence whether or not the apparatus is loaded to capacity. The apparatus is extremely reliable and is not susceptible to jamming. (B.L.M.)

Separation Processes and Procedures

See also Analytical Procedures.

ISOTOPE TECHNOLOGY — Separation and Production

Refer also to abstract 34302.

34266 (AEET-201) PILOT PLANT PRODUCTION OF NUCLEAR GRADE ZIRCONIUM SPONGE FROM INDIAN ZIRCON. (Atomic Energy Establishment, Trombay (India)). 1965. 57p. Dep.(mn)

The process utilizes the multiple recrystallization of K_2ZrF_6 for the removal of impurities; conversion to the oxide through precipitation with ammonia and calcination; chlorination of the oxide followed by reduction of the chloride with Mg; vacuum distillation for the removal of Mg and $MgCl_2$; and arc melting of the Zr sponge. (W.L.G.)

34267 (HW-SA-3484) NONLINEAR MODEL DETERMINATION OF CONCENTRATION PROFILES IN TWO-PHASE COUNTERCURRENT EXTRACTORS. Wilburn, N. P.; Nicholson, W. L. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Aug. 18, 1964. Contract AT(45-1)-1350. 27p. Dep.(mn); $2.00 (cy), 1(mn) CFSTI.

In two-phase continuous countercurrent extractors, the continuity equation describing the mass transfer process occurring may be written in the following form for the "rth" (either x or y) phase $\partial\epsilon_r c_r/\partial t = -\text{div}\,(E_r\epsilon_r \text{ grad } c_r) -$

$\text{div}\,(\mu_r \epsilon_r c_r) - \psi(c_r, c_s)$, where ϵ_r = volumetric fraction of the "rth" phase at (z, R, θ, t); c_r, c_s = concentration of the solute in the two phases at (z, R, θ, t); E_r = Fick type diffusion coefficient for the "rth" phase; μ_r = velocity of the "rth" phase; ψ = rate of mass transfer occurring between the two phases; and (z, R, θ, t) = cylindrical and time coordinates. The equation is solved for the same boundary conditions as previous work but ϵ_r is not held constant and c_r^* is assumed to be an arbitrary function of c_r. The solution is obtained by dividing the extractor into n segments. ϵ_r is assumed to be constant (or a linear function of z), and c_r^* is represented by $M_i c_r + q_i$ over the "ith" segment. This approach replaces the nonlinear systems by n linear systems. M_i, q_i, and the length of segment are chosen such that the set of n straight lines ($c_r = M_i c_r + q_i$, i = 1, ... n) represents the "best fit" to the nonlinear function $c_r^*(c_r)$ over the range of concentrations that c_r exhibits in the extractor. The solution for the two concentrations c_r, c_r and their space derivatives at the segment boundaries requires the inversion of a 4n by 4n matrix. It is shown that this problem is reducible to the inversion of n 4 by 4 matrices. A solution is obtained for a case typical of that occurring in the stripping column for the uranyl nitrate–water–TBP–kerosene system, where the equilibrium function c_r^* is approximately sigmoidal in c_r, and ϵ_r is an exponentially damped polynomial function of z. This solution is compared with that obtained by assuming that ϵ, M, q are constant over the extractor. (auth)

34268 (NP–15123) DESIGN DISCUSSION AND OPERATING PROCEDURE FOR FLUID BED DENITRATION. Harrell, R. K. (Mallinckrodt Chemical Works, St. Charles, Mo. Uranium Div.). Mar. 12, 1964. 15p.

Facilities were provided for the continuous denitration of a uranyl nitrate solution in two fluidized beds to produce UO_3; the design capacity is 15,000 tons U/year. A detailed description is given of the process, facilities, and operating procedure. (D.L.C.)

34269 EXTRACTION OF RADIUM FROM LIQUID WASTE BY MEANS OF MANGANESE DIOXIDE. Tyutrina, A. P.; Zhagin, B. P.; Bakhurov, V. G. At. Energ. (USSR), 18: 487-91(May 1965). (In Russian)

Application of amorphous manganese dioxide and pyrolusite for extraction of radium from uranium industrial waste waters was studied. Artificially prepared manganese dioxide coated on the sawdust or pyrolusite as suspension in a column are recommended as sorbents. The spent pyrolusite can be utilized as oxidizer of uranium ores. (R.V.J.)

34270 ION-EXCHANGE EXTRACTION OF THORIUM FROM MONAZITE. Carswell, D. J.; Hughes, K. C. (Univ. of New South Wales, Kensington, Australia). Australian J. Appl. Sci., 15: 329-33(Dec. 1964).

Phosphate inhibited the formation of the anionic nitrate thorium complex $Th(NO_3)_6^{=}$. A study of the effect of sequestering phosphate with iron in order that the anionic thorium complex may be formed without prior isolation of the phosphate was made. The principle was extended to the isolation of thorium of high chemical purity from monazite by anion exchange. (auth)

34271 SOLVENT EXTRACTION OF CESIUM (AND RUBIDIUM) FROM ORE LIQUORS WITH SUBSTITUTED PHENOLS. Arnold, Wesley D.; Crouse, David J.; Brown, Keith B. (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem., Process Design Develop., 4: 249-54(July 1965). (ORNL-P-485)

High-purity cesium salts were readily prepared from alkaline ore leach liquors by a solvent extraction method. In a simple continuous system the cesium was selectively extracted with substituted phenols in a hydrocarbon diluent and stripped with acid. Cesium recoveries from the liquor were >99% and separations from liquor contaminants, including other alkali metals, were highly efficient. In treating pollucite, a cesium aluminosilicate, the cesium was solubilized by roasting the ore with a sodium carbonate–sodium chloride mixture and leaching with water. Extraction with a 1M solution of 4-sec-butyl-2-(α-methylbenzyl)-phenol in kerosene, followed by scrubbing of the extract with dilute acid and stripping with carbon dioxide plus water, gave a cesium carbonate product solution with <0.01% combined alkali metal impurities. Rubidium can also be recovered and purified by this method. (auth)

34272 COUNTERCURRENT EXTRACTION IN SALT-METAL SYSTEMS INVOLVING OXIDATION-REDUCTION REACTIONS. Chiotti, Premo (Iowa State Univ., Ames). Ind. Eng. Chem., Process Design Develop., 4: 299-304 (July 1965).

The separation of solutes by countercurrent techniques in a two-phase system wherein the transfer of solutes between the two phases depends on an oxidation-reduction reaction of fixed stoichiometry is shown to be analogous to the separation of components in a distillation column. A flow diagram for separating two solutes, such as uranium and thorium, in a KCl–LiCl/zinc system is presented. Mathematical relations and graphical methods for determining the number of equilibrium stages required to effect a given separation were developed. The number of precipitate phases in the solvent streams must be limited for the countercurrent system to be operative. (auth)

34273 RADIUM REMOVAL FROM URANIUM MILL EFFLUENTS WITH INORGANIC ION EXCHANGERS. Arnold, W. D.; Crouse, D. J. (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem., Process Design Develop., 4: 333-7(July 1965). (ORNL-P-131)

The concentration of ^{226}Ra in uranium mill waste solutions is normally too high to permit their direct discharge to the environment. Radium was efficiently removed from simulated lime-neutralized acid waste by adsorption on a number of inorganic ion exchange materials, including barytes, Decalso (synthetic zeolite), and clinoptilolite (natural zeolite). In column tests, radium breakthrough was not significant until many thousands of bed volumes of aqueous feed had passed through the column. Adsorption efficiency decreased with increases in exchanger mesh size and in aqueous throughput rate. However, the radium capacity of the column was not changed appreciably by a fivefold change of radium concentration in the aqueous feed. Radium adsorption from highly contaminated acid wastes was not efficient. Ammonium nitrate (2M) eluted radium readily from clinoptilolite but less completely from barytes and Decalso. (auth)

34274 OXIDATION-FLUORINATION OF URANIUM DIOXIDE PELLETS IN A FLUIDIZED BED. Anastasia, L. J.; Mecham, W. J. (Argonne National Lab., Ill.). Ind. Eng. Chem., Process Design Develop., 4: 338-44(July 1965).

In pilot-plant development studies of a fluorination process for recovery of fissionable values from spent power reactor fuels, UO_2 fuel pellets were fluorinated to volatile UF_6 by reaction with elemental fluorine. The highly exothermic fluorination reaction was carried out in a fluidized-packed bed system, which consisted of two reaction zones: one for oxidation of UO_2 pellets to U_3O_8 fines (approximately 20 μ dia) and one for fluorination of U_3O_8 to UF_6. In the two-zone system, the less-exothermic oxidation reaction occurred in the fluidized-packed bed and the fluorination reaction took place in a superincumbent, fluidized bed where heat transfer coefficients were higher than in the fluidized-packed bed. Several methods of improving U_3O_8 fines transport from the oxidation zone to the fluorination zone were investigated; pulsation of the fluidizing gas was the most successful. With the pulsed system, 20-lb batches of UO_2 pellets were processed in about 12 hr at 500°C. Average production rates of 50 pounds of UF_6 (per hr per ft^2 of reactor cross-sectional area) and fluorine utilization efficiencies of 75% were achieved with good temperature control and absence of caking. These efficiencies included a fluorination period at the end of the run in which the last portions of uranium compounds were volatilized from the fluidized bed. (auth)

34275 EXTRACTION OF ALKALI METALS BY 4-SEC-BUTYL-2-(ALPHA-METHYLBENZYL)PHENOL (BAMBP).

Egan, B. Z.; Zingaro, Ralph A.; Benjamin, B. M. (Oak Ridge National Lab., Tenn.). Inorg. Chem., 4: 1055-61 (July 1965).

Cesium was efficiently separated from the lighter alkali metals by extraction with 4-sec-butyl-2-(α-methylbenzyl) phenol (BAMBP) in various organic diluents. Equilibrium measurements on the extraction process showed an inverse first-power dependence of the extraction coefficient on acid concentration in the pH range from 7.6 to 10.6 and a third-power reagent dependence in the concentration range of 0.1 to 1M. Loading data indicated a mole ratio of Cs : BAMBP of 1 : 4 in the organic phase. Higher metal to reagent concentration ratios could be obtained only at high pH values with concurrent extraction of water of hydration and an abrupt change in the extraction isotherm. Separation from lighter alkali metals was efficient only under those conditions, which did not permit extraction of the hydrated ion. The infrared spectrum of BAMBP, both in the fundamental and in the overtone region, was examined in various solvents. The dimer was the most abundant species except in the case of very dilute solutions. With cesium loading up to 1 Cs : 4 BAMBP, the spectra were characterized by a marked decrease in both the monomer and dimer absorption bands and a concurrent increase in the region of polymeric O–H absorption. NMR spectra showed a rapid downfield shift of the hydroxyl proton line with increasing cesium content to a maximum near 1 Cs : 4 BAMBP; then, with the extraction of more cesium, plus water, a reversal occurred with the shift returning upfield. The extent of the shift with other alkalies varied in the same order as their extractabilities, Cs > Rb > K. (auth)

34276 HEAD-END DISSOLUTION FOR PROCESSES AND UC–PuC REACTOR FUELS. Flanary, J. R. (Oak Ridge National Lab., Tenn. and Australian Atomic Energy Commission, Lucas Heights, New South Wales); Goode, J. H.; Bradley, M. J.; Ferris, L. M.; Ullmann, J. W.; Wall, G. C. Nucl. Appl., 1: 219-24(June 1965).

Three head-end processes that culminate in decontamination and recovery of uranium and plutonium by solvent extraction were evaluated on a laboratory scale, with unirradiated UC and with UC and UC–PuC fuel specimens irradiated to burnups of up to 20,000 Mwd/t. The most promising process was reaction with air-free steam (pyrohydrolysis) at 750°C followed by dissolution of the resulting oxide (UO_2 or UO_2–PuO_2) in nitric acid. Cesium was the principal fission product volatilized, but the amount was very low (about 0.5%). The oxide and fission products were dissolved in 6.5 HNO_3, yielding solutions suitable as feeds for Purex solvent extraction. Uranium and plutonium recoveries were greater than 99.9% in batch extraction tests. They were separated from fission products by a factor of at least 10^4. An alternative but less desirable process was direct dissolution in 13M HNO_3 followed by partial oxidation with acid permanganate of the soluble organic species formed. Plutonium losses of up to 0.4% occurred when the uranium and plutonium were stripped with dilute nitric acid after solvent extraction. Reaction of the carbides with water followed by dissolution of the oxides in nitric acid was an attractive process when tested with unirradiated materials, but this scheme was not feasible for irradiated carbides since they are relatively inert to boiling water. (auth)

34277 THE METHOD OF MEASUREMENT OF RADIOACTIVITY IN SEA WATER. Miyake, Y.; Sugiura, Y. (Meteorological Research Inst., Tokyo). Papers Meteorol. Geophys. (Tokyo), 9: 1957-9(May 1958).

To measure the gross radioactivity of fission products in sea water appropriate carriers are added to precipitate the active substance from the saline matter. A comparison was made of the efficiency of calcium carbonate, calcium phosphate, and a mixture of barium sulfate and iron hydroxide as carriers. The relation between the coprecipitation efficiency and the relative amounts of scavenger and sea water was also determined. (M.C.G.)

34278 SEPARATION OF AMERICIUM (III) FROM LANTHANIDES BY QUATERNARY AMMONIUM SALT EXTRACTION. Gerontopulos, P. Th. (SNAM-LRSR, Milan); Rigali, L.; Barbano, P. G. Radiochim. Acta, 4: 75-8(June 1965).

The extraction of americium(III) and the rare earth elements from ammonium thiocyanate solutions into xylene solutions of a quaternary ammonium salt (Aliquat-336) was investigated. It was found that good separation of americium from rare earths can be achieved by using moderately concentrated ammonium thiocyanate solutions. Extraction coefficients for americium and the rare earths were directly proportional to the amine concentration in the solvent. Extraction coefficients were affected by temperature changes, by the presence of various contaminant anions, and by the nature of the solvent used, but separation factors between americium and the rare earths remained essentially constant. Moderately high separation factors were obtained within the lanthanide group. (auth)

34279 ON THE BEHAVIOR OF NEPTUNIUM AND DIFFERENT FISSION PRODUCTS IN HETEROGENEOUS REACTIONS BETWEEN NEUTRON IRRADIATED URANIUM COMPOUNDS AND COMPLEX COMPONENTS. Lux, Franz; Ammentorp-Schmidt, Frits (Technische Hochschule, Munich). Radiochim. Acta, 4: 112-13(June 1965). (In German)

The separation of neptunium and various fission products from irradiated uranium dioxide by complex formation with phthalocyanines was studied. (M.C.G.)

34280 THE CHROMATOGRAPHIC SEPARATION OF Am–Cm ON PAPER. Knoch, W.; Lahr, H. (Technische Hochschule, Brunswick). Radiochim. Acta, 4: 114(June 1965).

A complete separation of plutonium(III), americium(III), and curium(III) on paper impregnated with tri-n-octylamine using ascending chromatography is possible. The eluting agent may be a nitrate salt solution containing a low HNO_3 concentration (3M $LiNO_3$ + 0.02M, HNO_3). A decrease of acid concentration below 10^{-3}M would promote hydrolysis. (F.J.H.)

34281 REACTOR FUEL PROCESSING. Volume 8, Number 2. Lawroski, Stephen, ed. (Argonne National Lab., Ill.). Spring 1965. $0.70(GPO) (Domestic), $0.90 (GPO) (Foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC). 76p. Dep.

The review is divided into seven sections dealing with commercial aspects of fuel processing, aqueous and nonaqueous processing, waste disposal, production of U and Th and their compounds, accidents, and papers from the 1964 Geneva conference. Separate abstracts were prepared for all seven sections. (D.L.C.)

For abstracts of individual sections see: 34193, 34282, 34283, 34284, 34285, 34420, and 35857.

34282 COMMERCIAL ASPECTS OF FUEL PROCESSING. Reactor Fuel Process., 8: 69-77(Spring 1965).

A review is presented of progress in processing plants in Europe, India, Norway, and U. S. The new Windscale plant and the U. S. development of fluidized-bed fluoride-volatility processing are discussed in some detail. Projections of fuel-cycle costs in U.K. are reviewed, and new studies of the costs of processing plants are discussed. Transport of irradiated fuels is reviewed. AEC-owned patents (foreign and domestic) on fuel processing are listed. (D.L.C.)

34283 RESEARCH AND DEVELOPMENT ON AQUEOUS PROCESSING. Reactor Fuel Process., 8: 78-87(Spring 1965).

A review is presented of the 1964 Geneva conference papers on aqueous processes, which were not previously discussed. Among the topics covered are preparation of fuels for recovery, solvent extraction processes, protactinium separation, and plant and equipment design and operation. Several Russian papers are discussed. (D.L.C.)

34284 RESEARCH AND DEVELOPMENT ON NONAQUEOUS PROCESSING. Reactor Fuel Process., 8: 88-110(Spring 1965).

A review is presented of the development of volatility

processes for high- and low-enriched fuels. The use of fluoride volatility processes to process the molten fluoride salt from the MSRE is discussed. The pyrometallurgical processing of EBR-II fuel in the EBR-II fuel cycle facility is reviewed in some detail along with other advanced pyrometallurgical processes and their development. Pyrochemical processes for oxide and carbide fuels are also reviewed. (D.L.C.)

34285 FUEL-PROCESSING PAPERS FROM THE THIRD GENEVA CONFERENCE. Reactor Fuel Process., 8: 137-40(Spring 1965).

A bibliography of 81 references is presented. Of the references, 76 are to 1964 Geneva papers on the subject of reactor fuel processing, while the remaining 5 are to other Geneva papers that contain some material on this subject. Two review articles are also listed. (D.L.C.)

34286 CHEMICAL PROCESS DEVELOPMENT. p.130-6 of "Fundamental Nuclear Energy Research, 1964." Washington D. C., Atomic Energy Commission, 1964.

The development of chemical processing methods for nuclear reactor fuels is reviewed, with emphasis on the fuel-salvage, reconversion, credit, and useful-waste aspects. The processes reviewed include solvent extraction, volatility separation, pyrometallurgy, analysis and chemonuclear research. (T.F.H.)

34287 PROCESS FOR SEPARATING PURE PLUTONIUM, THORIUM, AND URANIUM FROM IMPURITIES. Callari, Giacomo; Geoffroy, Andre (to Societe Europeenne Pour le Traitement Chimique des Combustibles Irradies (Eurochemic)). British Patent 991,418. May 5, 1965. Filed Oct. 12, 1961.

In a process for isolating a compound of Pu, U, or Th from contaminants, a solution of a salt of the metal complexed with a substituted ammonium compound in an organic diluent is treated with a precipitating agent, and the precipitate is separated from the solution and washed. The salt is a nitrate or sulfate, the ammonium compound is a tertiary amine nitrate or a quaternary ammonium nitrate, the diluent is a straight or branched chain aliphatic hydrocarbon and/or an aromatic hydrocarbon, and the precipitating agent is preferably hydrogen peroxide or oxalic acid. The precipitate may be calcined to obtain PuO_2, UO_2, or ThO_2. (A.G.W.)

34288 FLOCCULATION OF SELENIUM FROM A BASIC MEDIUM. Hart, James L.; Hawk, Darall G. (to Phillips Petroleum Co.). U. S. Patent 3,178,257. Apr. 13, 1965. Filed July 26, 1962.

The separation of precipitated elemental selenium from carbonate leach liquors formed in uranium ore processing is improved by treating the slurry containing the selenium with copper ammonium sulfate. The treatment causes flocculation of the precipitate, which allows more efficient filtration. For faster flocculating times, commercial flocculating agents may also be added. (A.G.W.)

34289 REMOVAL OF CONTAMINANTS FROM MILK. Silverman, Joseph (to Radiation Applications, Inc.). U. S. Patent 3,186,849. June 1, 1965. Filed Nov. 2, 1959.

An inexpensive process is described for the selective removal of Sr-90 from milk without the addition of harmful adulterants. The milk is either passed through a bed of an inorganic calcium salt, $CaCO_3$ or $Ca_3(PO_4)_2$; or the milk is contacted with the salt at a temperature ranging from the freezing point of milk to pasteurization temperature for a period of time varying from 2 min to 48 hr. A weight of Ca salt is added such that it contains 4 to 80 g/l of milk. After contacting the milk with the Ca salt, the excess salt along with the Sr-90 is removed by centrifugation or filtration. (B.L.M.)

ENGINEERING

General

34290 (AD-609289) BLAST PATTERNS IN COMPLEX TUNNEL MODELS. Teel, George D. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Apr. 1964. 54p. (BRL-TN-1533) $3.00(CFSTI).

A detonation-driven shock tube was utilized to expose four complex tunnel models to high pressure blast waves. The models were exposed to shock pressures of 200, 500, and 800 psi. The data obtained from the shock tube tests were reduced, plotted, and extrapolated to give expected values for the models when exposed to a 1500 psi shock wave from a 10 megaton nuclear weapon. (auth)

34291 (AD-613011) RADIATION AND RECEPTION OF ELECTROMAGNETIC ENERGY FROM AIRCRAFT AND GUIDED MISSILES. Final Report, February 1962–September 1964. Nanevicz, Joseph E. (Stanford Research Inst., Menlo Park, Calif.). Oct. 1964. Contract AF19(628)-325. 25p. (AFCRL-64-891) $1.00(CFSTI).

Descriptions are given of the various investigations undertaken on the research program conducted on missile and aircraft antennas. These investigations are grouped under three general categories: the effects of antenna environment upon its performance, experimental studies, and studies related to antenna systems. The relation of this work to other work at Stanford Research Institute and to the aircraft and missile antenna development program of the Air Force is briefly discussed. A list of the technical reports published on the contract is included. (auth)

34292 (BNWL-SA-76) DISASSEMBLY AND SAMPLING OF IRRADIATED MATERIALS IN THE UNITED STATES. Paper Communication No. 23. Boyd, C. L.; Watts, E. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.); King, E. M.; Dismuke, S. E. (Oak Ridge National Lab., Tenn.). [Mar. 1, 1965]. Contract AT(45-1)-1830. 17p. (CONF-650604-7). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From International Symposium on Working Methods in High Activity Hot Labs., Grenoble, France.

A survey is presented of cutting equipment and procedures used for remote disassembly and sampling of irradiated components in high activity research hot cells. Included are solutions to otherwise ordinary operating problems such as cutting waste collection and containment, equipment maintenance and lubrication, cutting tool changing and alignment, which are difficult under hot cell operating conditions. (auth)

34293 (BNWL-SA-134) DESALINATION OF SEA WATER. Harty, H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 12, 1965. Contract AT (45-1)-1830. 32p. (CONF-650432-1). Dep.(mn); $2.00 (cy), 1(mn) CFSTI.

From 53rd General Conference of Pacific-Northwest Trade Association, Portland, Ore.

After a brief survey of water resources and usage in the U. S., the means for meeting water shortages are considered: water re-use, storage, redistribution, and desalination of sea or brackish waters. The factors that will decide which of these methods will be used in a locality are discussed: water quality requirements, status of desalination technology, and water cost considerations. Sea water desalination is presently not widely competitive with other processes, but factors which may change this situation are discussed. (D.L.C.)

34294 (NYO-3363-3) AN INVESTIGATION OF ROTOR-BEARING DYNAMICS WITH FLEXIBLE ROTORS AND TURBULENT-FLOW JOURNAL BEARINGS. PART 1. ANALYSIS, DESIGN AND FABRICATION OF THE TEST APPARATUS. [Period Covered]: June 1964–February 1965. Orcutt, F. K.; Arwas, E. B. (Mechanical Technology Inc., Latham, N. Y.). Mar. 1965. Contract AT(30-1)-3363. 76p. (MTI-65TR-12). Dep.(mn); $3.00(cy), 2(mn) CFSTI.

A description is given of the preliminary part of an investigation aimed at demonstrating feasibility and generating technology and design procedures on high-speed rotors operating in the flexible rotor range while supported in pivoted-pad journal bearings lubricated with a low viscosity liquid and operating in the turbulent-flow regime. It is intended to operate three rotor arrangements over a speed range that, in each case, spans the first three system critical speeds and extends to above twice the first system critical speed. The rotor arrangements are: (a) central mass between two journal bearings, (b) central mass between the two journal bearings plus an overhung mass on one end, and (c) central mass between the journal bearings plus overhung masses on both ends. The analysis, design, and fabrication of the test apparatus is described. The calculated critical speed maps as well as the calculated vibration amplitudes and phase angles of the response of the rotor-bearings systems to unbalanced loads are presented. (D.L.C.)

34295 (SC-R-65-888) CONTAMINATION CONTROL CONSIDERATIONS FOR DESIGNERS AND MANUFACTURING ENGINEERS. Ballard, D. W. (Sandia Corp., Albuquerque, N. Mex.) Apr. 1965. Contract AT(29-1)-789. 9p. (CONF-735-2) Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From National Meeting of the American Association for Contamination Control, Los Angeles, May 1964.

Contamination and its control are considered from the viewpoint of reliable component and system production. Contamination considerations are outlined for each of the four stages of product life: design, manufacture, storage, and use. Contamination control procedures are also outlined. (D.L.C.)

34296 TURBINES. Stenning, Alan H. (Univ. of Miami, Coral Gables, Fla.). p.729-56 of Nuclear Rocket Propulsion. Gainesville Fla., University of Florida, 1964.

The characteristics of axial and centrifugal turbines are briefly compared, and expressions for the efficiencies and losses are given. Limits on turbine designs are then outlined, together with the principles for designing a turbine for a specific application. The evaluation of turbine performance under off-design conditions is also considered. (D.C.W.)

Applications of Nuclear Explosions

34297 (PNE-218F) RADIOACTIVE PELLET TRAJECTORY STUDY. Allen, J. (Lawrence Radiation Lab., Univ. of California, Livermore). Apr. 1965. Contract W-7405-eng-48. Project SEDAN. 36p. Dep.(mn); $2.00 (cy); 1(mn) CFSTI.

An attempt was made to investigate the manner in which earth is ejected ballistically from a nuclear cratering experiment. Eighty-eight radioactive pellets (^{60}Co) were buried at known locations and depths prior to the event. After detonation, a vehicle-mounted gamma scanner was used to survey the predicted angle of ejection and the northwest quadrant from ground zero. No preshot planted ^{60}Co sources were recovered. (auth)

34298 (PNE-315F) STUDIES OF THE PRE-BUGGY II APPARENT CRATERS. Spruill, Joseph L.; Videon, Fred F. (Army Engineer Nuclear Cratering Group, Livermore, Calif.). June 1965. Project PRE-BUGGY II. 128p. Dep.(mn); $1.50(cy), 3(mn) CFSTI

Five rows of five 1000-pound charges and one row of thirteen 1000-pound charges were detonated in the alluvial material at the Nevada Test Site. The charges were all fired at a depth of burst approximately 16% deeper than

the optimum for radius for single charges except for two of the five-charge rows which were detonated approximately 32% deeper than optimum. For the five-charge rows, spacings of 0.94, 1.06, and 1.17 single charge crater radii were used. For the thirteen-charge row, spacings of 0.94, 1.17, and 1.40 single charge crater radii were used. The resulting craters showed that when the charges are spaced one single charge crater radius apart, the row crater averaged approximately 10% wider and 20% deeper than the crater from a single charge of the same weight detonated at the same depth, 16% deeper than optimum for single charge crater radius. At wider charge spacings, the row charge crater is both narrower and shallower. When the spacing is about 1.30 single charge crater radii, the width of the row crater is about the same as the diameter of the corresponding single charge crater. When the spacing is about 1.22 single charge crater radii, the depth of the row crater equals the depth of the single charge crater. The cross section of the row charge craters at the shallower of the two charge depths appeared to be more nearly hyperbolic than parabolic as has been commonly assumed for the single charge crater. For a depth of burst 16% deeper than optimum for radius, the greatest volume per charge is excavated when the spacing is about 1.125 single charge crater radii. The lips along the sides of the row craters averaged about 2.4 times the average height of the lips around the single charge craters from the same charge weight at the same depth of burst. However, the lips at the ends of the row craters were generally smaller than those of the single charge crater, and were quite irregular in vertical section. There appears to be an increase in the height of the lips along the sides of the row craters as the depth of burst is increased. (auth)

34299 (POR-1826) DESIGN, TESTING, AND FIELD PUMPING OF GROUT MIXTURES. Marler, George V. (Waterways Experiment Station, Vicksburg, Miss.). July 1962. Project DANNY BOY. 16p. Dep. mn; CFSTI, $1.00 cy, $0.50 mn.

In Project DANNY BOY, a nuclear device of low yield was detonated in basalt at the Nevada Test Site. Pertinent physical properties of the basalt were determined and a grout mixture with matching properties for use in grouting scientific instruments in (grouted) holes drilled near the shot location was developed. 8 deep and 9 surface holes were grouted. Specimens of the field-mixed grout were cast to determine its physical properties at shot time. A satisfactory, pumpable grout was developed. Grouting of the holes was accomplished without difficulty, except that because of extremely cold weather, it was necessary to develop a quick-setting grout for the surface holes that would set before it froze. Due to the extremely cold weather, the test specimens obtained from the field-mixed grout froze before they could be properly cured in environmental conditions simulating those of the grout emplaced in the instrument holes. However, it is believed that at the depths at which the instrument canisters were placed, the ambient temperature and humidity approached those of the laboratory in which the grout mixture was developed. Therefore, it is believed that the compressive strength of the grout in the immediate vicinity of the instruments approached that of the basalt, and that the grouting operation was successful. (auth)

34300 (UCRL-7966) BARRIER-PLANNING WITH NUCLEAR CRATERING EXPLOSIVES. Circeo, Louis J. Jr. (Lawrence Radiation Lab., Univ. of California, Livermore). July 10, 1964. Contract W-7405-eng-48. 21p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Nuclear cratering has been shown to be a quick and efficient method for constructing effective obstacles for a defensive barrier system. The positioned emplacement hole could serve as a deterrent to a possible enemy advance through the area. Proper cratering parameters would ensure a crater or ditch of a specified length, width, and depth to block a selected location. The detonation could be conducted safely, with little effect on local communities or other portions of the barrier system. The area around the crater could be reoccupied immediately after the detonation to cover the obstacle by fire. Nuclear excavation technology has been developed sufficiently so that immediate application into barrier planning can be considered. Nuclear explosive development is such that the technology exists for the employment of large yield, clean nuclear explosives. Commanders should be made aware of this potential application of nuclear cratering explosives. In situations where this concept might be applicable, impassable obstacles could become a flexible on-call item and a great deterrent to possible enemy aggression. (auth)

34301 (UCRL-14155) REDUCTION OF PHOTOGRAPHIC SURFACE-MOTION DATA BY DIGITAL COMPUTER. Terhune, Robert W.; Fulton, Roger L.; Knox, J. B. (Lawrence Radiation Lab., Univ. of California, Livermore). May 12, 1965. Contract W-7405-eng-48. 39p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

A method for rapidly obtaining detailed surface-motion information from a high-explosive or nuclear cratering explosion is presented. The information is obtained from reading and analyzing, by means of digital computer, the film from high-speed photography of surface motion. The experimental requirements, description of computer programs, and analysis procedures are given. Samples of surface motion displacement, velocity, and accelerations acquired by this method from a specific event are presented and verified by standard techniques. (auth)

Facilities and Equipment

Refer also to abstracts 34265, 34422, and 35625.

34302 (HW-84384(p.4.1-9)) CHEMICAL RESEARCH AND DEVELOPMENT. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Pilot plant salt cycle processing experiments are described along with development of processes for radioactive residues. Work on containment systems experiments was devoted to program planning, equipment development, containment vessel coatings, and fission produce simulation. (J.R.D.)

34303 (LA-DC-6645) METHODS USED IN THE UNITED STATES HOT LABORATORIES FOR TRANSFERRING MATERIALS THROUGH GAMMA AND ALPHA-GAMMA BARRIERS. Schulte, John W. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [nd]. Contract W-7405-eng-36. 13p. Dep.mn; CFSTI, $1.00 cy, $0.50 mn.

Systems for transferring materials through hot cell walls are discussed for three categories: non-radioactive materials in gamma and alpha-gamma cells, radioactive materials in gamma barriers, and radioactive materials in alpha-gamma barriers. Transfer ports, shielded casks, isolation areas, and bagging techniques are considered. (D.L.C.)

34304 (SC-R-65-903) VERIFICATION OF CLEANLINESS—WHAT DOES IT MEAN. Jones, L. K. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1965. Contract AT(29-1)-789. 12p. (CONF-735-3) Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

From National Meeting of the American Association for Contamination Control, Los Angeles, May 8, 1964.

Factors that must be considered in the development of contamination control and cleanliness criteria are reviewed. Topics discussed include the identity, source, and effects of the contaminant; the establishment of contamination potential and control for low contamination levels; the establishment of the types and levels of contamination to be detected; and the development of comprehensive programs for the verification of the contaminant and control of verification tests. Contaminants are classified as hydrophobic, hydrophilic, or particulate, and a partial list of contaminant sources and of processing faults that lead to contamination is presented. Tests for cleanliness are evaluated. The use of radioactive tracer gave good results when used as a quantitative test for laboratory specimens. (C.H.)

34305 FOCUSED-BEAM ELECTRON BOMBARDMENT EVAPORATOR. Blackburn, D. H.; Haller, W. (National Bureau of Standards, Washington, D. C.). Rev. Sci. Instr., 36: 901-3(July 1965).

A simple focused-beam electron bombardment evaporator was developed for the controlled vaporization of carbon and other refractory materials. An electrically isolated cylindrical shield deflects and focuses the electron beam, allowing a large anode to cathode distance. This avoids interference by gas conductance, resulting in a more efficient and stable bombardment process. A performance comparison is made between the described evaporator and a conventional carbon-arc evaporator. (auth)

34306 IMPROVEMENTS IN OR RELATING TO PACKAGE IRRADIATION PLANT. Landon, Ernest Robert (to United Kingdom Atomic Energy Authority). British Patent 988,144. Apr. 7, 1965. Filed Sept. 26, 1960.

A package irradiation plant consisting of a γ source, a biological shield surrounding the source, and a railway for carrying packages on trolleys past the source is designed to minimize the space occupied by the railway track. The railway system has two monorail tracks, an inner track and an outer track, substantially parallel and so arranged that each track bends and turns back upon itself alternately within and without a bent portion of the other track. An operational procedure is suggested in which each package is conveyed around the track five times, occupying a different position on the trolley each time. (A.G.W.)

34307 IMPROVEMENTS IN ARC WELDING. Hetzler, Frank John; Moe, Aubrey (to Atomenergikommissionen). British Patent 988,212. Apr. 7, 1965. Priority date Nov. 14, 1962, Denmark.

An apparatus for arc welding has an arc moved in a track by a magnetic field. The magnetic field is provided by two magnets: one is placed around the welding electrode so that the majority of the lines of force emanating from it pass through the arc where it leaves the electrode; the other is placed around the work piece so that the majority of the lines of force emanating from it pass through the arc where it meets the weld. Preferably the magnet around the work piece is an electromagnet the field strength of which is controllable and which can be moved in a direction parallel to the axis through the welding electrode and the work piece. (A.G.W.)

34308 IMPROVEMENTS IN OR RELATING TO REMOTE CONTROL MASTER-SLAVE MANIPULATORS. (to Central Research Labs. Inc.). British Patent 989,793. Apr. 22, 1965. Priority date Mar. 27, 1961, United States.

A remote-control master-slave manipulator for operation through a barrier wall consists of a master arm assembly on one side of the wall, a slave arm assembly on the other side of the wall, and a seal tube assembly extending through the barrier wall. Rotary mechanical seal assemblies extend through a closed wall in the seal tube, and their opposite ends are connected respectively to the master arm and slave arm mechanisms. Double seals where motions are transmitted through the barrier and a system of monitoring the seals by gas pressure are proposed. The three main units are completely separable and individually replaceable. (A.G.W.)

34309 ROTARY MECHANICAL SEAL. (to Central Research Labs. Inc.). British Patent 989,794. Apr. 22, 1965. Priority date Mar. 27, 1961, United States.

A rotary mechanical seal for permitting the transmission of rotary motion through a barrier wall while preventing the transmission of radioactive and similar dangerous substances is particularly adapted to use with remote-control master-slave manipulators. The seal may be pressurized with gas to serve as a lock permitting continuous monitoring of seal integrity. (A.G.W.)

34310 WINDOW SEALING STRUCTURE FOR A LABORATORY GLOVE BOX. Saunders, George Thomas (to Kewaunee Mfg. Co.). British Patent 991,341. May 5, 1965. Filed Feb. 11, 1963.

A window sealing structure is patented, which employs a single gasket member disposed directly between the opposed edge portions of the inner surface of the pane and the adjacent face of the enclosure. The gasket has a plurality of sealing elements adapted to engage the surfaces involved so that each surface is sealed along a plurality of lines. The seal is visible through the window. (A.G.W.)

34311 PROCESS FOR THE STRATIFICATION OF A BODY OF LIQUID IN TWO SUPERPOSED LAYERS AND INSTALLATION FOR THE APPLICATION OF THE PROCESS. Dollfus, Jacques; Guilloteau, Rene (to Commissariat a l'Energie Atomique). British Patent 994,625. June 10, 1965. Priority date Mar. 26, 1963, France.

A process provides for the stratification of a body of liquid into two superposed layers without a mechanical device for the separation of the interfaces. The process is described for particular application to the swimming pool reactor to prevent the rise of highly contaminated water to the surface of the pool. Liquid is withdrawn from the bottom layer into a circulation system where it is cooled, and the greater portion is returned to the bottom layer. The portion not returned to the bottom layer is mixed with a portion withdrawn from the top layer, and all is contaminated and brought to a temperature that is higher than that of the water returned to the bottom layer. This water at a higher temperature is reinjected into the top layer. The installation provides circulation systems so that both layers continuously circulate and so that the top layer is always maintained at a substantially higher temperature than the lower layer to prevent diffusion of the layer of contaminated water to the top. (B.L.M.)

34312 DRUM-TYPE STORAGE DEVICE FOR RADIOACTIVE NUCLEAR SPECIMENS. Gerard, Victor; Javary, Bertrand (to Commissariat a l'Energie Atomique). British Patent 995,185. June 16, 1965. Priority date Aug. 3, 1962, France.

A drum type storage device for radioactive specimens includes a chamber having an aperture and contained in a radiation shielding casing. A rotatable drum member is located within the chamber. The drum member includes a radiation shielding cylinder recessed over some of its periphery and specimen receiving means secured in the drum member recess. The drum member is rotatable between a closed position in which the recessed portion of the cylinder is out of register with the aperture so that it is shielded from the exterior of the chamber and an open position in which at least a part of the recessed portion is accessible through the aperture so that a specimen may be accessible through the aperture. The drum member may be locked in the position of rotation in which the specimen receiving means is in correspondence with the aperture, and a plastic door is provided for closing the aperture. Indicating means are provided for indicating the position of rotation of the drum member. (B.L.M.)

34313 DEVICE FOR TRANSFERRING A PART INTO AND OUT OF A SEALED CHAMBER. Huttin, Raymond; Robin, Gerald (to Commissariat a l'Energie Atomique). British Patent 995,332. June 16, 1965. Priority date May 14, 1962, France.

A device is described for transferring a part into or out of a sealable chamber such as a glove box, having an aperture in its lower surface that is closed by a removable cover in the chamber. The device includes a transfer tank that contains the part and fits under the aperture of the chamber in a seal tight fit to essentially provide an extension of the chamber or glove box. The transfer tank is provided with a detachable sealing-tight cover. A movable carriage supports the tank and brings it to position beneath the aperture. The tank is provided with a peripheral groove housing a toric gasket for contact with the wall of the chamber, and a microcontact device controls the compression on the gasket. A lifting device lifts the tank with its cover removed to bring it into close sealed-tight contact with the chamber aperture. Movement of the aperture cover in the chamber enables the part to be transferred into or out of the chamber. (B.L.M.)

34314 ROTARY DISTRIBUTOR FOR LIQUIDS. Eymard, Jose; Pellerin, Achille (to Commissariat a l'Energie Atomique). British Patent 995,958. June 23, 1965. Priority date Mar. 6, 1963, France.

A distributor for liquids, particularly a radioactive effluent, includes an upper tank mounted for rotation about its vertical axis and a lower stationary tank that is mounted coaxially with the upper tank. The upper tank is suspended from the lower extremity of a vertical coaxial shaft fitted with an operating device by which the orientation of the upper tank can be varied. The liquid to be distributed is supplied to the upper tank through a vertical axial conduit extending through the lower tank and through the base of the lower tank, and an orifice is located off center in the upper tank. The lower tank is divided by radial partition walls into a number of compartments each connected with an outlet duct connected to the discharge circuit. The upper tank is rotated to bring its discharge office selectively above any one of the compartments. The apparatus is provided with a biological shield casing externally of the receiving and distributing tank. (B.L.M.)

34315 IMPROVEMENTS IN OR RELATING TO PHASE SEPARATORS. Bisby, Harry; Seymour, Frank Daniel; Snelling, Geoffrey Frank; Howard, Cecil Frederick (to United Kingdom Atomic Energy Authority). British Patent 996,012. June 23, 1965. Filed Nov. 23, 1961.

A phase separator for removing contaminating materials from a liquid includes a bi-conical chamber having an inflow conduit connected to it. First and second outflow conduits are connected respectively to the lower and upper parts of the chamber, and a delivery conduit leads from the central portion of the chamber for delivering substantially decontaminated liquid from the chamber. The volume of the chamber is such that the flow rate through the chamber is considerably lower than through the conduits so that phase separation can readily take place in the chamber. Baffle means in the chamber assist phase separation, and gas bleed vent means are provided. (B.L.M.)

34316 COUPLING MECHANISMS. (to General Dynamics Corp.). French Patent 1,345,144. Oct. 28, 1963. Priority date Nov. 7, 1961, United States.

A coupling mechanism for connecting a rod that has an enlarged head portion with an elongated shaft which has a lengthwise bore therein is described. The coupling mechanism comprises a female coupling member rotatably attached to one end of the shaft and means accessible through said bore for releasably locking the female coupling member to the shaft to prevent rotation there between. The female coupling member includes a bayonet-type socket which is proportional for receiving the enlarged head portion of the rod. The rod is locked to the shaft when the socket is rotated. (IIB)

34317 LEAK-TIGHT CONNECTING DEVICE BETWEEN TWO LEAK-TIGHT VESSELS. (to Commissariat a l'Energie Atomique). French Patent 1,346,486. Nov. 12, 1963. Filed Nov. 8, 1962.

A leak-tight connecting device permits either a communication between two leak-tight vessels or the separation from one another, these two operations being accomplished freely and independently. The tightness of the system is preserved and assured during the whole procedure such as to avoid any contamination of involved surfaces by manipulated products. (IIB)

34318 RADIOACTIVE SOURCE CONFIGURATION FOR PRODUCING A UNIFORM FIELD. Frank H. Attix. U. S. Patent 3,153,725. Oct. 20, 1964. Filed Jan. 30, 1961.

An irradiation facility for uniform irradiation includes two radiation sources for producing uniform radiation field and an object holder. Each source configuration includes a plurality of elongated tubular radiation source holders assembled side by side in a cylindrical configuration. Each holder comprises two axially aligned sections of radioactive material of equal field activity, and a linear spacer positioned along the axes of each tubular holder maintains a specific axial spacing between the radioactive sections in each holder. The irradiation facility includes the source holder for positioning the two sources of equal activity with their centers separated by a distance of $D = \sqrt{2R}$ along a line through their center and a cylindrical holder of radius, R, and length, $D = \sqrt{2R}$ upon which the objects to be uniformly irradiated are mounted. The cylindrical holder is symmetrically disposed with respect to the radiation sources with its axis passing along a line through the centers of the first and second source. (B.L.M.)

Heat Transfer and Fluid Flow

See also PHYSICS — General.

Refer also to abstracts 34699 and 35754.

34319 (BAW-3238-7) NONUNIFORM HEAT GENERATION EXPERIMENTAL PROGRAM. Quarterly Progress Report No. 7, January-March 1965. Judd, D. F.; Wilson, R. H.; Welch, C. P.; Lee, R. A.; Ackerman, J. W. (Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). Contract AT(30-1)-3238. 85p. (EURAEC-1366). Dep. (mn); $3.00(cy), 2(mn) CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Experimental and analytical investigations to determine how irregular heat flow through reactor channels affects the operating conditions that cause burnout are being conducted. This program seeks to improve design correlations that will be suitable for direct use by reactor designers. Tubular specimens with four axial power shapes and annular specimens with five power shapes are being used, and an effort to correlate the experimental data with empirical and analytical models will be made. During the seventh quarter the tubular data were revised slightly, using the latest heat balances. The data were carefully reviewed for self-consistency and compared with data of other investigators. The data were compared with previous burnout correlations, and progress on a correlation for nonuniform data is reported. Tests on the first annular test section have begun. (auth)

34320 (KAPL-3030) FLOPSY-II—A DIGITAL COMPUTER PROGRAM FOR CALCULATING FLOWS AND PRESSURE DROPS IN HYDRAULIC NETWORKS. Strain, B. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). June 1, 1965. Contract W-31-109-eng-52. 46p. Dep. (mn); $2.00(cy), 1(mn) CFSTI.

The FLOPSY-II code deals with the fluid flow distribution and pressure drop in any network of nodes and branches. It can handle either an open-loop or closed-loop circuit and variable resistances either in series or parallel. The basic equations used in the code are given, and the code is described in some detail. The input and output are described, and some sample problems are solved. (D.L.C.)

34321 (LA-DC-6578) NONLINEAR FUNCTIONAL EQUATIONS, AND THE STRUCTURE OF SOLUTIONS OF A STEADY STATE HEAT-FLOW PROBLEM. Pimbley, George H., Jr. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 41p. Dep.(mn); $2.00(cy), 1(mn) CFSTI

The nonlinear boundary value problem in the steady-state temperature distribution in a reactor with convective or radiative cooling is discussed. Solutions are derived for abstract functional equations of the type $x = \lambda T(x) + f$, where x is an element in a Banach space, T(x) is a nonlinear operator, and f is a given fixed element of the Banach space. Positive solutions of the equations are also discussed. The reduction of the boundary value problem to the form of these equations is considered. (D.L.C.)

34322 (NAA-SR-Memo-10971) CHARACTERISTICS OF THE 200-Mwe PROTOTYPE MODULAR STEAM GENERATOR COMPLEX. Logan, D. (Atomics International, Canoga Park, Calif.). Jan. 6, 1965. Contract AT-11-1-GEN-8. 83p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

The part load performance characteristics of the 200 Mw(e) Prototype Modular Steam Generator Complex were studied on an analog simulation. Performance characteris-

tics are presented for specific operating conditions. Also, a set of working curves were developed that allow the determination of performance characteristics for a limited range of control conditions. Two examples are worked up using these working curves. The constants used in the analog simulation and a diagram of the analog simulation are presented. In addition, a detailed presentation is made of the mathematical development of the equations used. This study is a steady state part load study and does not attempt to present transient phenomenon. A hand computed check was made at the 100% power condition. Other load cases were then determined for 25, 50, 80, and 110%. (auth)

34323 (NAA-SR-Memo-10994) SCTI—MODULAR STEAM GENERATOR CONTROL SYSTEM STUDY. Casey, D. F.; Cappel, H. H.; Bridges, C. H. (Atomics International, Canoga Park, Calif.). Feb. 4, 1965. Contract AT-11-1-GEN-8. 67p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

The mathematical equations describing the transient characteristics of the secondary sodium system, the modular steam generators and the feedwater/steam system adjacent to the steam generators were developed. The equations describing the control system were also developed. To accurately describe the transient behavior of a once-through steam generator a variable node length mathematical model was derived and used in the study. Checkout of this model on the analog computer was never completed because excessive values of $dL/d\Theta$ created instabilities. These excessive values could not be rate limited on the existing analog model and a new model could not be completed due to budget limitations; therefore, the study was terminated. The work done relative to deriving all the heat transfer, hydraulic and control equations is summarized. (auth)

34324 (NASA-CR-243) BOILING HEAT TRANSFER FOR CRYOGENICS. Seader, J. D.; Miller, W. S.; Kalvinskas, L. A. (Rocketdyne, Canoga Park, Calif.). June 1965. Contract NAS 8-5337. 179p. $5.00(CFSTI).

An extensive survey of available information from the literature on heat transfer to boiling hydrogen, nitrogen, and oxygen is presented. Included are a bibliography of available experimental data, a summary of boiling theory, graphical comparisons of the experimental data, and compilations of pertinent physical properties for each of the three cryogenic fluids. Based upon the results of the survey, recommendations are made for a test program to provide critical information where data are lacking. In all 152 references are given. (auth)

34325 (NP-15053) NATURAL CONVECTION IN A RECTANGULAR CAVITY WITH INTERNAL HEAT GENERATION. Internal Report 05031-2-I. Smith, Willy; Hammitt, Frederick G. (Michigan Univ., Ann Arbor. Lab. for Fluid Flow and Heat Transport Phenomena). Apr. 1965. 37p.

Natural convection flow in a closed cavity with internal heat generation, cooled along a pair of vertical side walls, and simulating the channels in an internally-cooled homogeneous nuclear reactor was studied both theoretically and experimentally. Although the experiment used water, the theoretical analysis considers fluids of arbitrary Prandtl number. A formal relation between the applicable non-dimensional parameters, following the one-fourth power law typical of natural convection, was obtained. Good agreement between experimental and theoretical results was also found. (P.C.H.)

34326 (TID-21881) A RADIO-RELEASE TECHNIQUE FOR TRACING STREAM FLOWS. Final Report. Richter, Harold G.; Gillespie, Arthur S., Jr. (Research Triangle Inst., Durham, N. C. Measurement and Controls Lab.). Aug. 31, 1964. Contract AT(40-1)-2513. 38p. Dep.(mn); $2.00(cy), $0.50(mn) CFSTI.

A radio-release technique for measuring the volume flow rate for streams has been developed. Sodium metavanadate or sodium dichromate is discharged into the stream at a known rate and water samples downstream are collected and assayed by pouring the samples through a radioactive silver column at pH < 3. Silver ion is released by the oxidation process and is assayed radiometrically. From the dilution factor, the volume flow rate of the stream can be calculated. Interferences from Fe(III) in natural water can be reduced or eliminated by complexing with a mixture of H_3PO_4 and ethylenediaminetetraacetic acid. Interference from Cl^- ion precipitation of the Ag^+ is eliminated by the addition of 1,3-diethyl-2-thiourea to complex the silver. Concentrations down to 0.1 ppm vanadium (V) or Cr(VI) can be determined. Suspended material in natural water presents a problem that was only partially solved. The method then is limited to systems with reasonably clear water. (auth)

34327 (UCRL-7990) TEMPERATURE OF A FLAT PLATE HAVING ALTERNATING ADIABATIC AND CONSTANT HEAT FLUX STRIPS ON ONE SIDE. Van Sant, James H. (Lawrence Radiation Lab., Univ. of California, Livermore). July 27, 1964. Contract W-7405-eng-48. 10p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The presence of adiabatic regions between strip heaters on one side of a flat plate can cause temperature variations on the convection-cooled side of the plate. The magnitude of the variations were estimated using Laplace's equation for steady-state heat conduction. Results are presented for various values of the plate thickness, half-width of the heated strips, and distance between heated and insulated strip centerlines. (D.L.C.)

34328 (WCAP-3269-10) STEAM GENERATOR WATER LEVEL CONTROL. Nahavandi, Amir N.; Batenburg, Abram. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Dec. 1964. Contract AT(30-1)-3269. 52p. Dep.(mn); $3.00(cy), 1(mn) CFSTI.

A combined digital-analog mathematical model for the dynamic analysis of vertical U-tube natural circulation steam generators is presented. The application of this model to the optimal design of a water level controller for a steam generating unit is demonstrated. It is shown that a control system consisting of standard proportional and reset controls on water level deviation from a desired set point and the difference between the steam and feedwater mass flow rates can be successfully employed for the control of water level in such a plant. The optimum values, as well as the range of the controller parameter settings for which the steam generator exhibits a desired stable response, are determined. (auth)

34329 TURBULENT COUETTE FLOW. Vilenskii, V. D.; Smirnov, V. P. At. Energ. (USSR), 18: 508-9 (May 1965). (In Russian)

Couette flow in a flat duct under a longitudinal pressure gradient was studied considering the possibility of four types of flow based on the relation between the rate of motion at the wall and the magnitude and the direction of pressure gradient. (R.V.J.)

34330 TEMPERATURE PULSATION OF THE TUBE WALL UNDER INTENSIVE CONVECTIVE HEAT-EXCHANGE. Subbotin, V. I.; Ibragimov, M. Kh.; Merkulov, V. I.; Nomofilov, E. V.; Tychinskii, N. A. At. Energ. (USSR), 18: 525-7(May 1965). (In Russian)

Temperature pulsations were measured in a double-pipe heat exchanger with the internal diameter of 24 mm, 2 mm wall thickness, 41 mm external diameter, and 3 mm wall thickness. The length of the heat exchanger is 900 mm. Coolants at various temperatures were pumped through both channels. The thermal fluxes varied from 1.3×10^5 to 6×10^5 ev/m^2. The experiments were carried out at Re range from 65×10^3 to 180×10^3. (R.V.J.)

34331 DYNAMIC BEHAVIOUR OF AGGREGATES OF NUCLEAR-HEATED GAS TURBINES. Bammert, K.; Klaeukens, H. (Technische Hochschule, Hanover). Atomkernenergie, 10: 157-62(May-June 1965). (In German)

Equations describing the dynamic behavior of individual aggregates of a gas turbine were formulated. The equations in question primarily embody the accumulation capacity of a pipe section with regard to both the gas volume and the kinetic energy. Their composition also allows equations pertaining to heat exchangers to be derived.

Equations concerning the static behavior of turbines and compressors were first specified. Their operational dynamic behavior is obtained by using machine components in place of the actual machines, whose mass moment of inertia corresponds to the gas column and storage capacity of the actual machines. (auth)

34332 FUNDAMENTALS OF FLUID MECHANICS FOR NUCLEAR ROCKET APPLICATIONS. Grey, Jerry (Princeton Univ., N. J.). p.143-245 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

Some aspects of fluid mechanics that are related to the analysis and design of nuclear rockets are discussed, including compressible flow, heat transfer, nozzle design, and boundary layers. (D.C.W.)

34333 HEAT TRANSFER AND FLUID DYNAMIC ASPECTS OF NUCLEAR ROCKET ENGINES. Kalvinskas, John J. (North American Aviation, Canoga Park, Calif.). p. 246-347 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

Heat transfer equations for both conduction and convective heat transfer are derived, together with the continuity, energy, and momentum equations for steady one-dimensional flow. A heat transfer model is considered in which a coolant channel is surrounded by two annular conducting regions of reactor core. The effects of coolant channel parameters upon power density are also treated, and the results of a parametric study of the core dimensions for a nuclear rocket engine using hydrogen as the propellant are presented. (D.C.W.)

34334 FUNDAMENTALS OF HEAT TRANSFER. Kutateladze, Samson Semenovich. Translation by Scripta Technica, Inc., of "Osnovy Teorii Teploobmena," second revised and augmented edition. New York, Academic Press Inc., 1963. 496p.

This book gives special attention to convective and turbulent heat transfer. The 21 chapters cover, respectively, fundamentals, heat transfer in a moving medium, equations of hydrodynamics, time-averaged equations for turbulent flow, boundary conditions, conditions of similarity in heat transfer, steady-state heat conduction in solids, unsteady heat conduction in solids without internal heat sources, fundamentals of convective heat transfer, forced convection for flow of incompressible fluid through pipes, incompressible boundary layer flow, gases at high velocities, rarefied gases, free convection, condensation of vapor on solid surfaces, condensation on a free jet, boiling, critical heat fluxes in boiling, thermal radiation, combined heat and mass transfer, and heat transfer calculations. (D.L.C.)

34335 IMPROVEMENTS IN HEAT EXCHANGERS FOR LIQUID METAL. (to Babcock and Wilcox Co.). British Patent 989,963. Apr. 22, 1965. Priority date May 3, 1961, United States.

A heat exchanger for effecting heat exchange between a liquid-metal heating fluid and a fluid to be heated consists of an upright vertically elongated pressure vessel having an inner upright tubular baffle arranged to divide the vessel into an inner cylindrical space and an outer annular space. The spaces communicate in a lower part of the vessel below the baffle and above a liquid metal outlet. Heat exchange tubes arranged for parallel flow of the fluid to be heated extend downward through the inner space from an upper inlet chamber and then upward in the outer space to an upper outlet chamber. An inert gas is supplied to the upper part of both spaces to cushion any pressure changes. (A.G.W.)

34336 HEAT EXCHANGE PROCESS AND DEVICE FOR ITS APPLICATION. (to Societe Nationale d'Etude et de Construction de Moteurs d'Aviation). French Patent 1,335,662. July 15, 1963. Filed July 13, 1962.

According to the process described, in particular adapted for application in a nuclear reactor, a vaporizable fluid flowing along the heat exchange surface has solid particles in suspension in order to promote heat transfer. The fluid movement consists of a flow in a general direction and in a whirl flow about said general direction, so that during the vaporization the particles are pushed against the heat transfer surface while the formed vapor bubbles are concentrated about the whirl axis. The flow velocity is sufficient to ensure the suspension of the particles in both the boiling and superheating region. The device for application of this process comprises means for imposing a whirl flow to the fluid suitably consisting of a twisted strip disposed in the axis of the heat exchange channel. (I.I.B.)

34337 IMPROVEMENTS RELATING TO MEANS FOR PREVENTING THE FLOW OF A PRESSURIZED FLUID WITHIN THE ANNULAR INTERSPACE FORMED BETWEEN TWO COAXIAL TUBES. (to Commissariat a l'Energie Atomique). French Patent 1,347,154. Nov. 18, 1963. Filed Nov. 13, 1962.

The channels of gas cooled nuclear reactors are often provided with an inner guiding tube adapted to enclose the fuel elements and placed within an outer tube such as to form an annular interspace between them. The hot pressurized reactor coolant flows through the inner tube, while a stagnant coolant of about the same pressure fills the interspace. Any gas flow is prevented by a gas tight sleeve fixed at one (suitably the inner) tube. It comprises at the up-stream side (with respect of the possible gas flow) a portion with a bowed contour resting elastically against the other (suitably the outer) tube. (I.I.B.)

Materials Testing

Refer also to abstracts 34425, 34625, and 35735.

34338 (EURAEC-1393) NON-DESTRUCTIVE WELDING TESTS. Quarterly Report No. 15. (Roentgen Technische Dienst N. V., Rotterdam (Netherlands)). May 31, 1965. Contract 045-61-5 RDH. 29p. (EUR-2353). Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Ultrasonic examinations were correlated with the appearance of discontinuities. Places of incomplete penetration were difficult to detect ultrasonically. The detection sensitivity for planar flaws could be increased by the use of two probes. Some cracks were produced by copper penetration. A complex flaw-echo envelope similar to that occurring with a gas cluster may be observed. Radiographic examinations were made of the test block with thickness up to 200 mm, using a ^{60}Co source. Best results were obtained with copper screens. (D.L.C.)

34339 (NASA-CR-54389) DETERMINATION OF ELEVATED-TEMPERATURE FATIGUE DATA ON REFRACTORY ALLOYS IN ULTRA-HIGH VACUUM. Quarterly Report No. 3, January 1–Apr. 1, 1965. Honeycutt, C. R.; Martin, T. F.; Sawyer, J. C. (TRW Equipment Labs., Thompson Ramo Wooldridge Inc., Cleveland, Ohio). Apr. 19, 1965. Contract NAS 3-6010. 19p.

Three of the four vacuum fatigue test chambers were installed and are undergoing proof tests. The drive train was designed and operated in air at room temperature and in vacuum at 2000°F. The transmission of the high frequency vibration through the vacuum chamber wall was accomplished with no significant problem by mounting a stepped horn to a Curvac flange at the nodal point. Based on the measurement of deflection in the terminating horns, strains of approximately 2×10^{-3} in./in. were developed in the test specimens, however, fractures were generally initiated in very short times in the mounting threads. Variations in specimen design are being studied to alleviate this problem. (auth)

34340 BIAXIAL BRITTLE FRACTURE TESTS. Manjoine, M. J. (Westinghouse Astronuclear Lab., Pittsburgh). J. Basic Eng., 87: 293-8(June 1965).

The brittle fracture characteristics of a particular steel can be evaluated by a notched specimen if sufficient triaxial tension or constraint is developed at the notch. A biaxially loaded notched test specimen was developed in which a crack-like notch was prepared by compressing a V-notch. Data obtained with this specimen were compared

to those of two other types of test and found to be more consistent and reliable. The test specimen can also be used in a neutron radiation program for determining the change in brittle fracture characteristics of stressed and unstressed materials. (auth)

Space Propulsion

See also REACTOR TECHNOLOGY — Propulsion and Space.

Refer also to abstracts 34333, 34998, and 35000.

34341 (AD-613047) A COMPARATIVE ANALYSIS OF THE PERFORMANCE CAPABILITIES OF VARIOUS TYPES OF ELECTROSTATIC PROPULSION ENGINES. Technical Note R-136. Cox, A. Lucile (Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.). Feb. 1965. 108p. $4.00(CFSTI).

The operating characteristics of three types of atomic ion engines and three types of colloidal ion engines are evaluated. The major theoretical factors which will limit payload capacity are brought out for each type of engine. Total propulsion system masses for the production of ten pounds of thrust for 2,000 hours and for 10,000 hours of engine operation are compared. Examination of the payload capacities of the various engines for several lunar and planetary missions shows that the colloidal ion engines have a superior payload capacity for lunar missions and may be competitive with atomic ion engines for planetary missions. The specific mass of the power supply system is shown to be a much more dominant factor in determining the payload capacities of the atomic ion engines than for the colloidal ion engines. (auth)

34342 (MND-3169-67) NIMBUS SATELLITE STABILITY STUDY. Scheider, M. G. (Martin Co., Baltimore, Md. Nuclear Div.). June 1965. Contract AT(30-1)-2345. 27p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

An investigation was conducted of the re-entry behavior of the Nimbus/SNAP 19 system with the solar platforms folded and unfolded. The pitch motion of the satellite was analyzed using a three-degree-of-freedom program. The results show that there is a good probability that the generator will re-enter without complete disintegration and burnup under some conditions. Therefore, it is recommended that the SNAP 19 generator system be separated from the spacecraft to assure burnup. (D.L.C.)

34343 (N64-22453) TRANSVERSE FIELD ION ENGINE DEVELOPMENT. Summary Report (Final). Huss, W. N.; Eckert, A. C. (TRW Electromechanical Div., Thompson Ramo Wooldridge Inc., Cleveland, Ohio). Mar. 1964. Contract NAS8-2527. 84p. (NASA-CR-54054; TRW-ER-5847) $8.10(CFSTI).

A gaseous discharge possessing good ion-focusing properties was investigated and applied to the design of an ion source for electric propulsion. An ion source was fabricated and underwent initial performance-evaluation tests with both argon and mercury propellants. Tests of ion-source performance with a mercury propellant were made. The performance data were obtained with an ion source that used an accel–decel extraction system. Major efforts were made to solve the problems of ion-source efficiency, ion acceleration, and nickel-matrix dispenser cathodes. The transverse-field ion source appears useful in the space-propulsion application because of its excellent efficiency, high propellant utilization, and good lifetime potential. (auth)

34344 (SC-RR-65-129) STABILITY ANALYSIS OF THE RFD-2 FLIGHT TEST VEHICLE. Paris, F. L. (Sandia Corp., Albuquerque, N. M.). June 1965. Contract AT(29-1)-789. 40p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The theoretical and experimental determinations of the aerodynamic coefficients of the RFD-2 re-entry vehicle are presented. The resulting coefficients are incorporated into an aerodynamic analysis of the re-entry trajectory where the changes of configuration and the resultant changes in the physical and aerodynamic parameters of the vehicle are considered. Radar and camera-tracking data were obtained from the flight test which took place October 9, 1964. These experimental trajectory data correlated with the calculated trajectory within 400 feet of distance or 1 second of flight time throughout the re-entry flight. (auth)

34345 PLASMA THRUSTORS FOR SPACE PROPULSION. Miller, David B. IEEE (Inst. Elec. Electron. Engrs.), Spectrum, 2: No. 6, 36-45(June 1965).

When the molecules of a gas are ionized so that the gas becomes a conductor of electricity (plasma), the gas may then be accelerated by electromagnetic forces. Inasmuch as attainable velocities are higher than can be reached by accelerating a hot gas through a nozzle and because the magnitude of the magnetic force is appreciable, this method of producing high-velocity gas is being seriously studied for use in a reaction (rocket) engine. The need for this type of thrustor, based on the propulsion requirements for space exploration missions, is considered. Techniques of plasma propulsion are treated. It is seen that much is to be learned about the physics of a plasma and the technology of a plasma engine; also that the most likely application for these engines is in deep space missions in the future. (auth)

34346 PLASMA ACCELERATION BY ELECTRON CYCLOTRON RESONANCE. Hendel, H.; Faith, T.; Hutter, E. C. (RCA, Princeton, N. J.). RCA Rev., 26: 200-16 (June 1965).

Results are presented for a continuously operating electron cyclotron resonance plasma accelerator at a frequency of 2.45 kilomegacycles with absorbed power levels up to 0.5 kw. Langmuir-probe measurements indicate that a space-charge field set up by energetic electrons (electron temperatures from 5 to 25 ev) accelerates plasma ions to energies of from 35 to 150 ev, as measured by a retarding-field ion-energy analyzer. The final ion energy shows a linear relationship to the electron temperature, in agreement with the theory. Strong electron confinement along magnetic field lines is observed in the discharge region. At powers up to 10 w, approximately 30% of the absorbed microwave power is converted into kinetic energy of the ions when a magnetic bottle is formed at the rear of the accelerator. When a similar bottle is used with a power of 0.5 kw, the efficiency falls to 4%. It is believed that this reduction is due to strong excitation in the magnetic bottle region, where electrons are connected by the magnetic field lines to the waveguide walls. The fact that low- and high-power efficiencies have been found comparable for other magnetic field shapes indicates that an accelerator designed to exclude field-line connections between wall and plasma should yield efficiencies of at least 30% at the higher power levels. The specific impulse, efficiency, and thrust attainable from a thruster based on electron cyclotron resonance are in the useful range for space-propulsion applications, especially in orbit-corrective missions. The absence of sensitive accelerating or electron-emitting electrodes promises long lifetime for such a thruster. (auth)

34347 PROPULSION FOR BOOSTERS AND SPACECRAFTS. Reichel, Rudolf H. (VDI, Bellevue, Wash.). VDI(Ver. Deut. Ingr.) Z., 107: 560-4(Apr. 1965). (In German)

A review of the most recent studies on boosters and spacecraft is presented. After a brief indication of the general trends, chemical, nuclear, and electrical propulsion devices are described. 83 references. (J.S.R.)

34348 ELECTRIC PROPULSION AND POWER SUPPLY SYSTEMS FOR SPACE VEHICLES. Guenther, F. Au. VDI (Ver. Deut. Ingr.) Z., 107: 564-9(Apr. 1965). (In German)

A review of the most recent studies on electric propulsion and power supply systems is presented. 89 references. (J.S.R.)

34349 NUCLEAR ROCKET PROPULSION. Notes for the 1962 National Science Foundation Advanced Subject

Matter Institute. Watson, Clayton W., ed. Gainesville, Fla., University of Florida, 1964. 972p.

Separate abstracts were prepared for fifteen of the nineteen papers included. The remaining papers deal with the designs of 200- and 60,000-Mw nuclear rockets and with mission analyses for these vehicles. (D.C.W.)

For abstracts of individual papers see: 34296, 34332, 34333, 34350, 343351, 34352, 34353, 34354, 34355, 34857, 35720, 35841, 35842, 35843, and 35844.

34350 BASIC ROCKET PROPULSION. Williams, David T. (Univ. of Florida, Gainesville). p.30-57 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

A brief analysis of rocket propulsion is presented, covering the mass ratio, lift-off from an airless earth, ascent from the air-covered earth, and structural weight requirements. The procedure for finding the optimum distribution of staging is outlined, and a trip to the moon is treated as a numerical example. (D.C.W.)

34351 MATERIALS FOR NUCLEAR ROCKET PROPULSION. Rhines, Frederick N. (Univ. of Florida, Gainesville). p.58-142 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

A survey on the properties and technology of fuel, moderator, shielding, and structural materials for nuclear rockets is presented. Welding and radiation effects are covered, together with the bases for high- and low-temperature behavior. (D.C.W.)

34352 FEED SYSTEMS. Stenning, Alan H. (Univ. of Miami, Coral Gables, Fla.). p. 672-728 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

An analysis of turbopump systems for nuclear rockets is presented. Two different arrangements for tapping the gas flow through the reactor to drive the pump turbine are considered. (D.C.W.)

34353 OPERATIONAL CONSIDERATIONS. Bussard, Robert W. (Space Tech. Labs., Redondo Beach, Calif.). p.757-802 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

The optimization of the performance of nuclear rockets is treated, with consideration of both high- and low-acceleration flight. The effects of reactor specific mass and of the propellant specific impulse on performance are considered, together with the relation between these two parameters. (D.C.W.)

35354 ADVANCED CONCEPTS. Bussard, Robert W. (Space Tech. Labs., Redondo Beach, Calif.). p. 803-32 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

Some advanced concepts for space propulsion are briefly examined, including a gaseous vortex reactor, nuclear-electric systems, direct-conversion reactors, liquid-fuelled reactors, fusion reactors, and the Orion concept in which nuclear explosions are used. (D.C.W.)

34355 REACTOR DESIGN TOPICS. Bussard, Robert W. (Space Tech. Labs., Redondo Beach, Calif.). p. 833-907 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

Some considerations in the selection of structures, configurations, and materials are outlined, and thermal stresses and strains are analyzed. Reactor core support concepts are also discussed; and reactor characteristics, control concepts, and non-ideal effects and transient conditions are briefly treated. (D.C.W.)

34356 ELECTROSTATIC PROPULSION SYSTEM WITH A DIRECT NUCLEAR ELECTRO GENERATOR. Low, Charles A., Jr.; Mickelsen, William R. (to NASA). U. S. Patent 3,184,915. May 25, 1965. Filed Jan. 21, 1963.

An electrostatic propulsion system is proposed that includes a direct-nuclear-electro-generator and uses few moving parts and negligible high temperature fluid systems. An electrostatic thruster is included in which decaying radioisotopes are used to obtain the high voltage direct current necessary to operate the thruster. The system has a very low mass-to-power ratio and is suitable to provide the propulsion for very fast interplanetary flights. (B.L.M.)

Vacuum Engineering

34357 (N64-24831) EXTREME VACUUM TECHNOLOGY (BELOW 10^{-12} TORR) AND ASSOCIATED CLEAN SURFACE STUDIES. Bryant, Paul J.; Gosselin, Charles M.; Taylor, Lyle H. (Midwest Research Inst., Kansas City, Mo.). July 1964. Contract NASr-63(06). 75p. (NASA-CR-84). $2.00(CFSTI).

Experimental results are discussed in the following areas: development of extreme vacuum technology using the vapor-jet mechanism and a helium permeation guard technique; determination of the quantities and species of gas above gettering-ion pumps and chemically trapped oil diffusion pumps; derivation of a physical adsorption isotherm for inert gases; development of a total-pressure gage for readings below 10^{-12} torr; and investigation of the adhesion or cold-welding tendency of metals exposed to vacuum and thermal outgassing. (auth)

34358 (UCRL-7925-T) COMMENTS ON PUMPING METHODS FOR OBTAINING ULTRAHIGH VACUUM. Milleron, Norman (Lawrence Radiation Lab., Univ. of California, Livermore). June 4, 1964. Contract W-7405-eng-48. 9p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A departure from standard practice is taken. Ultrahigh vacuum is not taken to be synonymous with a region of pressure only. Rather, vacuum is regarded as a permissive environment in which to work. A suggestion for a scale of vacuum permissiveness in grades from 1 to 20, 20 being defined as a perfect sink over 4π solid angle, is given. Pumping efficiency and where a pump begins are referred to. Brief remarks about combinations of pumps, especially cryo and titanium sublimation pumps, are given. (auth)

34359 TITANIUM EVAPORATOR OPERATING IN A STRONG MAGNETIC FIELD. Vinogradov, M. I.; Ulyanov, V. F. Pribory i Tekhn. Eksperim., No. 3, 175-7(May-June 1965). (In Russian)

An electron-ray Ti evaporator, operating for an extended period in a magnetic field of intensity 1 to 3 kOe, is described. (tr-auth)

GEOLOGY AND MINERALOGY

General

34360 (AD-608225) A STUDY OF THE FEASIBILITY OF USING NUCLEAR VERSUS SOLAR POWER IN WATER EXTRACTION FROM ROCKS. Scientific Report No. 1. Green, J. (North American Aviation, Inc., Downey, Calif. Space Sciences Lab.). July 31, 1964. Contract AF19(628)-3292. 252p. (AFCRL-64-733; SID-64-1430). $6.00 (CFSTI).

Theoretical and experimental research on nuclear versus solar power is presented relative to the extraction of water from predicted lunar surface materials. Various problem areas are outlined that cover reactor and solar heat sources, techniques involved in the analysis of materials to be used with these heat sources, and the engineering and logistics aspects of using these energy sources. Welded tuff and altered volcanics are thought to be the best material for obtaining water in lunar basing operations. (auth)

34361 (AD-609555) STRESS PROPAGATION IN SOILS. Final Report, Part IV. Seaman, L.; Whitman, R. V. (Stanford Research Inst., Menlo Park, Calif.). June 1964. Contract DA-49-146-XZ-018. 309p. (DASA-1266-4) $7.00(CFSTI)

Wave propagation in soil was studied and methods for predicting wave propagation phenomena based on data from laboratory compression tests on soil samples were developed. The study was restricted to one-dimensional wave propagation in a sand and a clay. Extensive wave propagation tests were made on 5-meter columns of Monterey sand of various densities subjected to transient loads of different intensities and duration. Stresses and particle velocities were measured at various locations in the column to test the validity of theoretical models representing sand. The main feature of stress wave propagation—stress attenuation—can be predicted for sand on the basis of a rate-independent model. In addition, wave front development, wave velocity, particle velocity attenuation, and duration of the stress wave are described qualitatively by this model in combination with a second rate-independent model. The parameters of the models can be determined from static or dynamic compression test data on small samples of sand. (auth)

34362 (NVO-98-6) INTERIM PROGRESS REPORT, TASK IV—ATOLL SITE SURVEY. Pollard, Dwight D.; Wilson, George L. (National Marine Consultants, Anaheim, Calif.). May 1965. Contract AT(26-1)-98. 21p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

A survey was conducted of proposed atoll sites for the installation of Type II transducers. Information is presented for the recommended sites at Wake, Canton, and Johnston Islands. (D.L.C.)

34363 SOVIET ADVANCES IN NUCLEAR GEOPHYSICS. Alekseev, F. A. Translation of Yadernaya Geofizika. New York, Consultants Bureau, 1965. 195p. $27.50.

Seventeen papers are included; an abstract was prepared for each. (L.B.S.)

For abstracts of individual papers see: 34364, 34374, 34375, 34383, 34384, 34385, 34386, 34387, 34388, 34389, 34390, 34391, 34392, 34393, 34394, 35369, and 35370.

34364 DISTRIBUTION OF TRACE ELEMENTS IN WATER AND ROCK OF OIL DEPOSITS IN THE SARATOV-VOLGOGRAD REGION OF THE VOLGA AND ITS SIGNIFICANCE IN PETROLEUM EXPLORATION. Korobov, D. S. p.171-8 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

Studies were conducted to determine the features of underground waters from the relations in the distribution of of microelements in perched waters of the calcium chloride type. Microelements were determined by spectral analysis of the dry residues with an autocollimated, quartz spectrograph and with a triple-prism, glass spectrograph. Li, Sr, Mn, Ba, Cu, Cr, and Al were detected, and distribution profiles and contents obtained from the spectral analysis are shown. It is assumed that the containing rock is the main source of microelements in perched water and that their accumulation in the oil-associated waters is connected with the geochemical and biochemical environments produced by the oil and gas deposit. (L.B.S.)

Natural Radioactivity and Fallout

See also HEALTH AND SAFETY.

Refer also to abstracts 33740, 33746, and 34479.

34365 (HASL-161) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, MARCH 1–JUNE 1, 1965. Hardy, Edward P. Jr.; Rivera, Joseph (Health and Safety Lab., New York Operations Office (AEC), N. Y.). July 1, 1965. 319p. Dep.(mn); $4.00(cy), 5(mn) CFSTI.

Current data are presented from the HASL Fallout Program, the National Radiation Laboratory in New Zealand, Argonne National Laboratory, and the Instituto de Energia Atomica in São Paulo, Brazil. Radionuclide levels in monthly fallout, milk, tap water, diet, and upper air samples are given in tabular form. Also included are interpretive reports and notes dealing with global strontium-90 fallout measurements through 1964 and estimated deposition through 1965, strontium-90 fallout in Antarctica, surface air measurements of debris from the first and second Chinese tests, and 1964 strontium-90 levels in human bones. A bibliography of recent literature pertinent to nuclear debris studies is given. (auth)

34366 (NP-15079(p.17-27)) CANADIAN FALLOUT DATA FOR FEBRUARY 1965. Samuels, E. R.; Mohindra, V. K. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

Data are presented on radioactivity due to fallout in samples of atmosphere, precipitation, and milk collected in Canada during Feb. 1965. Data are included on the content of ^{137}Cs and ^{90}Sr in milk samples. (C.H.)

34367 CONTENT OF ^{90}Sr IN RADIOACTIVE FALLOUT OVER WEST SLOVAKIAN TERRITORY. Chupka, Sh.; Petrashova, M.; Tsarakh, I. (Regional Sanitary-Epidemological Station, Brastislava). At. Energ. (USSR), 18: 496-9(May 1965). (In Russian)

The absolute and relative content of ^{90}Sr in radioactive fallout was measured at four points of western Slovakia during 1962-1963. A considerable rise in ^{90}Sr content (up to 12%) was observed during November and December 1963. It was concluded that the present radioactive fallout consists of stratospheric origin isotopes with long half life. (tr-auth)

34368 THE CONTENT OF Pb^{210} IN THE ATMOSPHERE AND IN ATMOSPHERIC PRECIPITATIONS. Baranov, V. I.; Vilenskii, V. D. At. Energ. (USSR), 18: 503-6 (May 1965). (In Russian)

Data are presented on the ^{210}Pb fallout in the Moscow region in 1961-1963. The mean ^{210}Pb concentration in the fallout was not related to the amount of precipitation and increased sharply only during drought periods. The intensity of ^{210}Pb fallout was practically static during spring, summer, and autumn and reduced by a factor of 2 to 2.5 during winter. The mean concentration of ^{210}Pb does not depend on the season. The mean yearly ^{210}Pb fallout intensity is ~2.8 nC/m^3. The concentration of ^{210}Pb in the air over the Pacific and Indian Oceans fluctuated from (0.1 to 16.0) $\times 10^{-3}$ nC/m^3. Variations in ^{210}Pb concentration in air over the ground and the ocean could be used for studying meteorological factors inducing the transfer of radioisotopes in the troposphere and their fallout on the earth's surface. (tr-auth)

34369 FRACTIONATION OF RADIOACTIVE ISOTOPES IN HOT PARTICLES. Gaziev, Ya. I.; Malakhov, S. G.; Nazarov, L. E. At. Energ. (USSR), 18: 535-7 (May 1965). (In Russian)

Fractionation of ^{141}Ce, ^{103}Ru, and $^{95}Zr + ^{95}Nb$ in various hot particles was measured in the Moscow region in 1962. Aerosol samples collected at sea level and 5000 m were grouped according to their β activity. The content of $^{141}Ce + ^{144}Ce$, ^{103}Ru and $^{95}Zr + ^{95}Nb$ was measured with a γ spectrometer with the order of error not exceeding 10% and ^{103}Ru not exceeding 20%. The maximum error in determining the activity ratio of $A(^{95}Zr + ^{95}Nb)/A(^{141}Ce + ^{144}Ce)$ was 15% and for $A(^{95}Zr + ^{95}Nb)/A(^{103}Ru)$ and $A(^{103}Ru)/A(^{141}Ce)$ was 25%. The tabulated data on fractionation of hot particles ^{103}Ru and $^{141}Ce + ^{144}Ce$ in ratio to $^{95}Zr + ^{95}Nb$ and in relation to β activity showed that in 10^{-10} C particles and over there is a shortage of ^{103}Ru and $^{141}Ce + ^{144}Ce$ in proportion to $^{95}Zr + ^{95}Nb$; in particles with a high level of β activity the content of ^{103}Ru is negligible in comparison to $^{95}Zr + ^{95}Nb$. (R.V.J.)

34370 STRONTIUM-90 IN BONE. Brit. Med. J., 1: 1320 (May 15, 1965).

Human bone assayed in 1964 continued to show effects of 1961 and 1962 weapons tests. Values for the bones of children up to the age of four were considerably higher than those for the first half of 1963 and somewhat higher than those for the second half of 1963. (BBB)

34371 EFFECT OF SANITIZING PROCEDURE ON CHEMICAL ASPECTS OR PROCESS FOR REMOVAL OF RADIONUCLIDES FROM MILK. Murthy, G. K.; Brazis, A. R. (Robert A. Taft Sanitary Engineering Center, Cincinnati). J. Dairy Sci., 48: 300-5 (Mar. 1965).

Previously, a procedure for sanitizing resin and regenerant solution was developed in the process for removing cationic radionuclides from milk. An investigation was undertaken to find out whether the sanitizing treatment applied to the resin and regenerant solution affected the removal of ^{85}Sr and ^{137}Cs and the cationic composition of milk. The efficiency of stripping adsorbed radioactivity on the resin by the regenerant solution, including reuse and conservation of radioactivity in the regenerant, were also studied. The milk tested was labeled with ^{85}Sr in vitro, whereas the ^{137}Cs present was that from natural contamination from fallout. Analysis of treated milk showed ^{85}Sr removal of 95.1, 92.1, and 89.8% at milk flow rates of 0.0625, 0.125, and 0.25 resin bed volume/min (rbv/min), respectively. These values conform with thoses obtained under lab conditions by using milk labeled with ^{85}Sr in vivo, indicating that the sanitizing treatments had no effect on ^{85}Sr removal. The removal of ^{137}Cs was about 65% at all the milk flow rates studied. The nitrogen distribution and the cationic composition of milk before and after resin treatment were not significantly different, showing that the presence of NH_4^+ and Na_2SO_3 in the efficiency of regenerant solution had no effect on resin regeneration characteristics. The earlier resin regeneration procedure was improved. This also resulted in a 40 to 45% saving in the cost of salts used in the regenerating solutions. It is suggested that a milk flow rate of 0.125 rbv; that is, operation of the column for 4 hr, be used as a compromise between chemical and microbiological aspects of the process. The Ca, K, and Na content of milk samples analyzed before and after resin treatment showed no apparent change in the cationic composition of untreated and composited treated milks. (BBB)

34372 RADIOACTIVE SUBSTANCES IN THE HUMAN ORGANISM. Voedroes, Daniel (MTA Orvosradiologiai Kutato Csoport, Budapest). Magy. Radiol., 17: 107-14 (Apr. 1965). (In Hungarian)

A review is given of world-wide fallout data and specifically ^{90}Sr and ^{137}Cs measurements. It is suggested that present radiation levels constitute no danger, but further creation of fallout should be discontinued. (BBB)

34373 FALLOUT CONCENTRATIONS OF SOME RADIONUCLIDES FROM 1963 THROUGH 1964. De Bortoli, M.; Gaglione, P.; Malvicini, A. (EURATOM, Ispra, Italy). Nucl. Instr. Methods, 35: 177-9 (1965).

The techniques used at Ispra to determine the concentrations of radionuclides in rain are summarized, with emphasis on the use of a sum-coincidence spectrometer. Results obtained in the 24 months of 1963 and 1964 for ^{137}Cs, ^{89}Sr, ^{90}Sr, ^{103}Ru, ^{106}Ru, ^{141}Ce, ^{144}Ce, $^{95}Nb + ^{95}Zr$, ^{124}Sb, ^{125}Sb, ^{7}Be, ^{54}Mn, ^{22}Na, ^{60}Co, and ^{88}Y are presented and discussed. (D.C.W.)

34374 EXPERIENCE WITH SPECTROMETRIC MEASUREMENTS OF THE NATURAL GAMMA-FIELD OF THE EARTH FOR RADIOMETRIC SURVEYING FOR OIL. Grumbkov, A. P.; Semenov, G. S. p.161-70 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

The use of γ-spectroscopy along with radiometric surveying as one of the basic methods for prospecting for deposits of various ores is considered from the standpoint of the individual determination of the rock content of elements of the thorium series, the uranium and radium groups, and of ^{40}K. The physical conditions of the earth's surface is discussed for the possibility of γ-spectrometry. Studies of the spectra composition of natural γ-fields above oil structures were carried out both with gas-discharge counters and scintillation detectors. The results of the investigations are discussed. (L.B.S.)

34375 A STUDY OF THE GAMMA-FIELDS ABOVE OIL AND GAS DEPOSITS. Omes, S. P.; Bondarenko, Yu. V.; Zakharova, N. I.; Borkov, F. P. p.179-89 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

An analysis was made of radioactive logs from operating and exploratory wells in the Chelbass deposit and in the Kushchev area in order to study radiochemical anomalies and the possibility of developing a relation between the results of radiometric surface surveys and the distribution of radioactivity along a profile. Distribution profiles are shown and the results are discussed. (L.B.S.)

34376 INTRODUCTION OF SYSTEMATIC STUDIES OF THE VARIATION OF C^{14}-CONTENTS IN THE ATMOSPHERE FOR THE PAST THOUSAND YEARS. Kigoshi, K. (Gakushuin Univ., Tokyo), Hasegawa, H.; Yamakoshi, K.; Oda, M.; Shibata, S.; Saito, K. p.466-9 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The long-term variation of the ^{14}C content of the atmosphere was investigated by measuring the ^{14}C content of rings of an old cedar tree taken from Yaku Island, Japan. The variation of the geomagnetism was also estimated, and the variation of the ^{14}C content expected to result from this variation was calculated. (D.C.W.)

Techniques and Equipment

Refer also to abstract 34585.

34377 (AD-609851) A LARGE APERTURE SEISMIC ARRAY. Group Report 1965-1. Green, P. E., Jr. (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). Jan. 6, 1965. 30p. (ESD-TDR-65-26). $2.00(CFSTI)

The Large Aperture Seismic Array is an experimental system designed to provide improved capability for seismic discrimination of nuclear explosions and earthquakes. This improvement is to be brought about by suppression of reverberation and microseismic noise relative to the signal through the use of a larger number of sensors and a larger array aperture than previously employed in seismic arrays for this purpose. A brief sketch of the way in which the signal improvement is to be achieved, followed by a short physical description of the various parts of the entire array design as it is currently envisioned, including the choice of sensors, array geometry, signal telemetry, and signal processing is given. (auth)

34378 (PAEC(A)IN-646) APPLICATIONS OF RADIOISOTOPES IN HYDROLOGY. A Literature Search. (Philippine Atomic Energy Commission, Manila). Dec. 1964. 19p. Dep.(mn).

Sixty-six references on geology and mineralogy; isotope technology, meteorology, physics, and waste disposal and processing are given to journals and reports published from 1948 through to 1964. Separate corporate and personal author indexes are included. (P.C.H.)

34379 (RME-143) THE GAMLOG COMPUTER PROGRAM. Scott, James H. (Grand Junction Office (AEC), Colo. Production Evaluation Div.). Sept. 1962. 46p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

In the GAMLOG computer program deflections in gamma-ray logs of uranium ore zones are tabulated and submitted with certain control data to be keypunched on standard 80-column IBM cards according to an established format. The entire assemblage is then submitted to the computer center where data on the cards are transferred to magnetic tape for input to an IBM 7090 computer. The time interval during which the computer develops the results for GAMLOG from input data is about 1 minute for 100 average-sized logs. During this interval the computer obeys instructions set forth by the GAMLOG program, performing arithmetic calculations and making decisions based on simple logic. GAMLOG results come out of the 7090 computer on magnetic tape that is later interpreted by a small, special-purpose computer coupled to an off-line, high-speed printer. Although there is no limit to the number of logs that can be interpreted by GAMLOG, the present program limits to 90 the number of log readings for a single log. The GAMLOG program is used to interpret any gamma-ray log that does not show significant time-constant distortion and is made with equipment having a response similar to that of AEC logging equipment. (auth)

34380 (AEC-tr-6578) NEW RADIOACTIVITY LOGGING INSTRUMENTS. Gulin, Yu. A.; Semenov, E. V.; Semenova, T. M.; Bernshtein, D. A.; Kupovykh, P. N. Translated from p.3-18 of Yadernaya Geofizika, Gostoptekhizdat, Moscow, 1962. 22p. Dep.(mn); CFSTI, $1.00(cy), 1(mn); JCL; $2.60(fs), $0.86(mf).

A new cement gage, VUF-1, was developed with the gamma-gamma logging method as the basis. The characteristics of the VUF-1 gage are described. A new model, VUF-2, was also developed for wells with high temperatures. Typical cementograms are given. The three-channel RK apparatus for porosity determination is described, and the advantages of neutron-neutron logging are discussed. The circuits are described in some detail. (D.L.C.)

34381 DATING OF ANCIENT CERAMICS BY THERMOLUMINESCENCE. Ichikawa, Yoneta (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 43: 1-6(Jan. 1965).

Preliminary studies were made on thermoluminescence dating of ancient pottery. The natural glow-curve resulting from ancient pottery was found to differ from the artificial glow-curve after ^{60}Co gamma irradiation in the shape of the low-temperature region. In the case of the Yayoi pottery, these two glow-curves were found to be similar in the high-temperature region for the sample prepared by washing and separating the grain. Thus, this technique is suggested for measurement of the absorbed dose of ancient ceramics. However, in comparison with the natural glow-curves of the Jomon and Sue potteries, the deformation of the glow-curve was observed even in the high-temperature region. The results of chemical analysis showed that these samples contained some organic material. (auth)

34382 THE EFFECTS OF FLUID INVASION IN PULSED NEUTRON LOGGING. Allen, L. S.; Mills, W. R.; Caldwell, R. L. (Socony Mobil Oil Co., Inc., Dallas). Geophysics, 30: 389-95(June 1965).

The weak dependence of the results of pulsed neutron logging on the presence of the oil well borehole suggests that thermal neutron die-away measurements in an open hole may be capable of "seeing" beyond a limited amount of borehole fluid invasion. In order to obtain an estimate for the depth of investigation which can be expected from pulsed neutron logging when some invasion has occurred, multigroup neutron diffusion theory was used to calculate thermal neutron lifetimes for the open-hole logging geometry. The transient, three-group equations were solved with the aid of an IBM 7090 computer. Two cases of open-hole fluid invasion were investigated: Fresh-water filtrate invading a salt-water-saturated formation, and salt-water filtrate invading a formation saturated with fresh water (or oil). In both cases the formation is assumed to be a 20 percent porosity sandstone and the fluid-filled borehole is taken to be 20 cm in diameter. It is shown that for any given depth of borehole fluid invasion, up to the point of total masking, it is much easier to detect the presence of oil behind salt-water invasion than to detect salt water behind a zone invaded by fresh water. (auth)

34383 SOLUTION OF THE BOUNDARY VALUE PROBLEM IN THE THEORY OF PULSED NEUTRON LOGGING. Polyachenko, A. L. p.35-61 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

A rigorous foundation is given for the suitability and applicability of the integral transform method for solving the boundary value problem in pulsed neutron logging theory arbitrarily distributed sources. An exact solution of the particular boundary value problem valid for all times t is constructed and transformed into a form suitable for numerical computation, and the dependence of the structure of the solution on the relations between the physical parameters of both media is established. (L.B.S.)

34384 ASYMPTOTIC TIME DISTRIBUTION OF NEUTRONS IN PULSED LOGGING. Polyachenko, A. L.; Kantor, S. A. p.62-90 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

An investigation is made to describe the relations between pulsed neutron–neutron logging (PNNL) diagrams and the rock characteristics which would allow an estimate to be made of the dependence of the relative differential strata on borehole radius, rock parameters, time, etc. The boundary value problem for a point-pulsed neutron source located on the axis of a liquid-filled borehole, which penetrates a uniform stratum of great thickness, is solved by the method of integral transforms. The physical significance of the solutions are discussed for the weak and strong absorption cases and the results are analyzed. (L.B.S.)

34385 NEUTRON DISTRIBUTION IN A BOREHOLE AFTER SOURCE CUTOFF. Glauberman, A. E.; Tal'yanskii, L. L. p.91-6 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

The problem of a point source of fast neutrons on the axis of a filled borehole, which operates during the time interval $(-\infty, t_0)$ and which is turned off at the instant $t = t_0$, is considered, and the neutron distribution in the borehole for $t > t_0$ is investigated. Expressions are obtained for the neutron flux along the borehole axis and at the boundary. (L.B.S.)

34386 DEPTH OF ROCK STUDIES BY MEANS OF PULSED NEUTRON LOGGING WITH A FAST NEUTRON SOURCE. Kantor, S. A. p.97-103 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

The depth of the rock studies using pulsed neutron logging with a thermal neutron point source was previously considered. The radius of rock investigation is made for the case of a neutron generator used as a source in pulsed neutron logging in which the neutrons are produced as a result of the d-t reaction and have energies of approximately 14.2 Mev. Calculations of the distribution of slowing down neutrons in arbitrary compositions are carried out in an approximation that assumes that the distribution obeys the age equation. (L.B.S.)

34387 THE DISTRIBUTION OF NEUTRONS IN MEDIA WITH CYLINDRICAL INTERFACES FOR THE CASE OF OFF-AXIS SOURCE LOCATION. Kobilyanskii, V. B.; Tal'yanskii, I. I.; Glauberman, A. E. p.104-9 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

The problem of neutron distribution for a case where a point source is not located on the borehole axis is considered. The treatment is restricted to the two-group approximation, considering water-bearing media. It is shown that the use of off-axis sources can give more exact information about the rock surrounding a borehole. (L.B.S.)

34388 ON THE SOLUTION OF THE NEUTRON LOGGING THEORY PROBLEM BY THE GROUP METHOD. Kulinkovich, A. E. p.110-20 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

The group method is described for the solution of problems in the theory of radioactive methods for investigating boreholes. Green's function for neutron density in the n-th group is considered in the case of uniform space. Expressions are obtained for the extinction density of neutrons in the presence of a cylindrical interface between media with different neutron properties. (L.B.S.)

34389 CALCULATION OF NEUTRON DISTRIBUTIONS IN MEDIA SEPARATED BY PLANE BOUNDARIES. Bilen'kii, B. F.; Vladimirov, V. V. p.121-3 of Soviet Advances in Nuclear Geophysics. New York Consultants Bureau, 1965.

A solution for the problem of neutron distribution in media with specified properties which are separated by plane boundaries is considered for the study of the behavior of neutron fluxes in the transition from one stratum to another and for the evaluation of the dependence of neutron distribution on the distance from the source to the borehole wall. The neutron flux was computed for a unit source located in drilling mud for various source distances from the media, for various porosities of an oil-bearing limestone stratum, and for various distances from the detector along the axis. The results are both tabulated and plotted. (L.B.S.)

34390 NEUTRON DISTRIBUTION IN MULTILAYERED MEDIA FOR A POINT FAST NEUTRON SOURCE. Barsukov, O. A.; Avzyanov, V. S. p.124-8 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

The distribution of neutrons in multilayered media is described by a system of multigroup integrodifferential equations, and a method for solving the system is presented. Calculations were made for the distribution from a point polonium-beryllium source located in an infinite, uniform water medium for twelve energy groups. Two-group calculations were made of neutron distribution in a five-layered medium consisting of air, iron, water, cement, and rock in the geometry of a cased borehole. Five-group calculations were also made for limestone of 30% porosity containing fresh water and penetrated by an uncased borehole. Experimental studies were performed and compared with theoretical results. (L.B.S.)

34391 USE OF THE GAMMA-ACTIVATION METHOD FOR STUDYING ROCK SAMPLES. Sulin, V. V. p.129-43 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

The deficiencies of thermal neutron activation analysis for the investigation of the material content of rocks are pointed out. Results from the development of the method of γ-activation analysis of rock samples are presented, and the types of photonuclear reactions which can be realized practically for material analysis are discussed. The principal possibilities for the use of the γ-activation method for rock analysis based on the use of the (γ,n) reaction are discussed, and the reaction parameters for various isotopes of elements found in rock are tabulated. The characteristics of the radioactive products of the (γ,n) reaction in various nuclei are given along with the values for the threshold energies of these reactions. (L.B.S.)

34392 CHOICE OF THE OPTIMAL GAMMA-RAY ENERGY FOR DISCRIMINATING OIL- AND WATER-BEARING STRATA BY THE PHOTONEUTRON METHOD. Berzin, A. K.; Kislov, A. N.; Meshcheryakov, R. P.; Mikhailov, G. P.; Sulin, V. V. p.144-9 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

An experiment was performed to estimate the optimal γ-ray energy in the 5 to 10 Mev range which corresponds to the greatest difference in the photoneutron yields for oil and water. A laboratory betatron whose maximum energy could be varied was used as a source of hard γ-radiation, and a cadmium-shielded NaI(Tl) scintillation counter was used as a photoneutron detector. The results of the measurements are shown. (L.B.S.)

34393 POSSIBILITY OF USING PHOTONUCLEAR REACTIONS FOR DEFINING AN OIL-WATER INTERFACE. Mazyukevich, N. P.; Parlag, A. M.; Shkoda-Ul'yanov, V. A. p.150-2 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

Calculations are presented for the yield of photoneutrons from water and oil exposed to photon beams, for deuterium in water, deuterium in oil, and ^{13}C in oil. The shower theory of Belen'kii and Tamm was taken as the basis for calculations in the energy range 2.25 to 15 Mev. Photoneutron yields for several energies resulting from the action of electrons and photons are tabulated for comparison and curves are presented of the yields as a function of photon energy. (L.B.S.)

34394 POSSIBLE USE OF INFORMATION THEORY IN THE INTERPRETATION OF BARREN LOGS FROM RADIOACTIVE LOGGING. Yanovskii, A. K. p.153-7 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

A method using information theory for selecting the useful anomalies associated with features of the geologic profile from a background of heavy interference is presented for the interpretation of radioactive logging charts. (L.B.S.)

34395 PULSED NEUTRON SOURCE UTILIZING AN ACCELERATOR TUBE. Hoyer, Wilmer A.; Rumble, Robert C. (to Esso Production Research Co.). U. S. Patent 3,185,849. May 25, 1965. Filed Nov. 30, 1962.

A neutron generator includes a closed accelerator tube containing an open-ended cylinder sealed inside the tube. An extraction electrode is arranged adjacent to one end of the cylinder that is divided into an ionization chamber and an acceleration chamber by a screen. The ionization chamber is filled with deuterium or tritium plasma and means are included for ionizing the plasma. A target positioned adjacent to the lower end of the accelerating chamber consists of a thin metal disc of Pt, Cu, Mo, stainless steel, or Ni. A deuterium target may be formed naturally inside the tube if Zr target blanks are subjected to impingement by deuterium ions across the accelerating gap. Tritium targets may also be used. Means are provided for supplying high voltage pulses to the target and extraction voltage pulses to the extraction electrode. The tube also contains control means mounted in the accelerator tube for adjusting the pressure of the tritium or deuterium gas within the tube to reactivate it. The screen electrode is preferably formed concave-convex with the size of the screen openings increasing in a radial gradiation. A delay network in the extraction circuit provides an economical introduction of ions into the accelerating chamber. (B.L. M.)

Thorium and Uranium Minerals

34396 URANIUM IN THE BASIC ROCKS OF PATYN AND BOLSHOI KUL TAIGA IN MOUNTAINOUS SHORIA. Zhuravlev, R. S.; Asipov, D. K. (Inst. of Geology and Geophysics, Academy of Sciences, Novosibirsk, SSR). Geokhimiya, No. 4, 490-4(Apr. 1965). (In Russian)

The average percentage of uranium in the basic rocks of Patyn and Kul Taiga is 4.3×10^{-5}%, which is close to the average percentage of U in basic rocks of the earth's crust. In the presence of settling of basic intrusions, the concentration of uranium decreases. Crystallization of the acid rocks is accompanied by successive increase of the percentage of uranium to the final stage of settling massives and to dikes and veins of their phases. Potassium is not directly correlated with the concentrations of uranium rocks. (tr-auth)

HEALTH AND SAFETY

See also BIOLOGY AND MEDICINE — Radiation Hazards and Protection.
GEOLOGY AND MINERALOGY — Natural Radioactivity and Fallout

Refer also to abstracts 34277, 34304, and 34358.

34397 (BNL-9188) RADIATION TOLERANCE FROM FALLOUT IN PROTECTIVE STRUCTURES. Conard, Robert A. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT-30-2-GEN-16. 11p. (CONF-650415-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From National Academy of Sciences Protective Structures Symposium, Washington, D. C.

The protection afforded by shelters against the hazards of close-in fallout radiation associated with nuclear detonations is discussed. The process of fallout formation is reviewed. It is pointed out that the hazards associated with fallout are primarily due to the γ and β irradiations associated with the fission products in the fallout material and include penetrating whole-body γ radiation, irradiation of the skin from deposit of fallout material on the body, and internal absorption of radioactive materials from air breathed and food and water consumed. Studies on the Marshallese population exposed to fallout in 1954 following the experimental detonation of a thermonuclear device exemplified these three types of hazards and showed that penetrating γ radiation is by far the most serious of the hazards. The importance of protective structures as related to each of the hazards of fallout is considered. It is concluded that the attenuation of the γ radiation through shielding structures will result in considerable degradation and scattering of the incident radiation so that a good portion of the radiation dose may be too soft to reach the bone marrow, the most critical organ system. Survival will be probable if the radiation dose to the bone marrow is not over 200 rads in 24 hr. Shelters would offer complete protection against skin burns from fallout and the hazard of internal absorption of fallout should not be significant in the shelter. It is pointed out that no special ventilation precautions should be necessary for shelters since sufficient air to maintain life during the actual period of fallout will filter in the cracks and after that time a door or window may be opened for short periods to refresh the air. (C.H.)

34398 (BNWL-SA-125) ENVIRONMENTAL MONITORING LECTURE NOTES. Soldat, J. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1965. Contract AT(45-1)-1830. 67p. (CONF-650529-1). Dep.(mn); $3.00(cy), 2(mn) CFSTI.

From Health Physics Certification Training Course, Richland, Wash.

Criteria for environmental monitoring programs for radioactivity are presented. Standards for public exposure and the basis for maximum permissible concentration values are discussed. The value of pre-operational surveys, operation surveys, and emergency surveys in environmental monitoring programs is considered. The environmental monitoring program at the Hanford Area is described. (90 references). (C.H.)

34399 (CVNA-155) CVTR EMERGENCY PROCEDURES. Lewis, Lionel (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). July 1962. Revised June 1965. Contract AT(30-1)-2289. 27p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Procedures are established to deal with all station emergencies. These emergencies include fire, medical injury and illness, radiation and contamination accidents, and conditions that may result from a nuclear accident. (M.O.W.)

34400 (IDO-10043(Vol.I)(Rev.1)) ACCIDENT RECOVERY EQUIPMENT STUDY — AEC-DRD REACTORS. VOLUME I. Cuffia, R. J.; Flora, H. E.; Lazar, A. H.; Lewis, R. H.; McCarty, W. T.; Ryan, R. F. (Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). June 1965. Contract AT(10-1)-1202. 63p. Dep.(mn); $3.00 (cy), 2(mn) CFSTI.

Equipment needed for recovery from accidents, both nuclear and nonnuclear, is considered. An analysis of 13 past accidents provides a basis for future requirements. The accident recovery capabilities of 27 representative reactors are considered in terms of an accident postulated for each installation for which recovery presents a major problem. These 27 reactors were chosen to offer sufficient variety in design, purpose, and size. Site locations are also varied — from densely populated areas to remote, hard-to-reach locations. Some of these reactors are adjacent to additional reactors on the same site, where mutual support is available. Other selected reactors are isolated and consequently have a greater need for self-sufficiency. The equipment requirements are thus related to the existing reactors and their individual construction features and locations. Certain equipment is needed immediately and therefore should be kept on hand at the reactor sites. Equipment for the later phases of accident recovery can be shipped in from a distance. The recommendations concerning specific items of equipment are stated in terms of on-site or off-site placement. A summary is presented of accident recovery equipment recommended for ready availability. Personnel rescue problems, which are closely related to accident recovery operations are also reviewed. (auth)

34401 (N64-24119) SOME MAJOR HAZARDS IN GOVERNMENT-SPONSORED ACTIVITIES. Hassialis, Menelaos D.; Bernstein, Robert I.; O'Neill, Lawrence H. (Columbia Univ., New York). Jan. 1964. 143p. (NASA-CR-56623) $11.00(CFSTI).

The possibility of accidents is inherent in the various activities directly or indirectly sponsored by the government, particularly in the areas of defense, space exploration, and energy production and control. In recent years these governmental activities have been characterized by an exponential rate of growth; increasingly by their dependence upon the use and control of larger and larger quantities of energy; by increasing reliance on automation; and by reduction of the time scale allowable for the achievement of goals. All of these characterizing features normally increase the probability of occurrence of accidents. Fortunately, paralleling these events truly phenomenal strides have been made in the safety programs accompanying each of these activities. Improved materials and engineering, application of quality control of manufactured products, and other steps taken have improved components and systems reliability to previously unbelievable levels. Correctly it may be said, that the risk of accidents in any particular program is extremely remote, but the programs multiply. Viewed as a whole, these ever increasing activities pose a significant threat of accidents; further, with the controlled use of increasing quantities of releasable energy these threatened accidents may be of major proportions. Data are summarized from publicly available information. It is concluded that accidents of major proportions can occur. The examples of certain credible catastrophic accidents cited should not be regarded as predictions of future events; nor should the dollar estimates of the damage which may be caused be considered other than a very rough attempt to establish magnitude in terms of a monetary yardstick. Many assumptions were available in trying to estimate damages. Where specialists were consulted as, for example in the insurance field, their responses generally served only to suggest a range, sometimes a frustratingly wide range. In such cases, the authors have adopted unit estimates on the

conservative side of the range. Almost no attempt was made to estimate intangible losses, e.g., loss of income by business interruption and the like. (C.H.)

34402 (NP-15079) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 3, Number 3. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.). Mar. 1965. 34p. Dep.(mn).

Separate abstracts were prepared on three sections of this report. (C.H.)

For abstracts of individual sections see: 34366, 34403, and 34404.

34403 (NP-15079(p.3-16)) GUIDE LEVELS IN RADIATION PROTECTION PROGRAMS. PART II. Booth, A. H. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

Radiation protection programs in Canada are based on the recommendations of the International Commission on Radiological Protection (ICRP) and no system of protection guides has been developed specifically for use in Canada. Secondary guides prepared by the Medical Research Council of the United Kingdom and the Federal Radiation Council of the United States were adopted for situations involving exposures of the general population to dietary contamination after the accidental release of radioactive material from a nuclear reactor and for the maximum content of ^{131}I in daily milk intake for various age groups, respectively. Radiation protection guides from a number of sources are discussed and compared with ICRP guides. (C.H.)

34404 (NP-15079(p.28-33)) REACTOR ENVIRONMENT MONITORING FOR FEBRUARY 1965. Samuels, E. R.; Mohindra, V. K. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

Data are presented from environment monitoring studies near the sites of the Chalk River reactors, the Nuclear Power Demonstration reactor near Ralphton, and the Candu reactor at Douglas Point during Feb. 1965. (C.H.)

34405 (NP-15096) INTRODUCTION TO RADIOLOGICAL DEFENSE PLANNING. Miller, Carl F.; Lee, Hong; Sartor, James D. (Stanford Research Inst., Menlo Park, Calif.). May 1965. Contract N228-(62479)65421. 65p.

Basic radiological data, major parameters, and equations are presented for use in the calculation of the radiation dose from fallout for populations exposed during nuclear warfare. Sample calculations are included for three operational routines. The influence of shelter availability, shelter efficiency, length of shelter occupancy, and time after detonation on radiation dose are considered. Correction factors are included for use in the basic exposure-dose equations when fallout arrival time is longer than one hour after detonation. Applications in planning radiological defense and countermeasures are discussed. (C.H.)

34406 (NP-15097) EXPLORATORY ANALYSIS OF FIRE STORMS. Rodden, Robert M.; John, Floyd I.; Laurino, Richard (Stanford Research Inst., Menlo Park, Calif.). May 1965. Contract N228-(62479)65419. 72p.

An evaluative review of existing knowledge and opinion relating to fire storm phenomenology is presented. Interim critical values of fire storm parameters that may be used in target analyses to establish conditions for possible occurrence of fire storms were developed. The basic factors in initiation and development of fire storms are identified and organized into a format to serve as the framework for a fire storm model. The casualties resulting from fire storms are discussed, and a possible method for predicting fire entrapment areas is presented. It was concluded that major parameters and constraints affecting the initiation and development of fire storms include fuel loading, initial fire density, size of the initial fire area, surface wind, and topography and configuration. Factors which in general appear to determine the extent and nature of fire storms, as opposed to their possible existence, include combustibility, fire intensity buildup rate, atmospheric stability, temperature, humidity, and precipitation. Recommendations are given for further investigations to improve the state of knowledge in those areas where valid information is lacking. (auth)

34407 (ORNL-P-1265) BEHAVIOR OF IODINE IN THE NUCLEAR SAFETY PILOT PLANT MODEL CONTAINMENT VESSEL. Parsly, L. F.; Franzen, L. F.; Holz, P. P.; Row, T. H.; Wantland, J. L. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 23p. (CONF-650407-5). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From International Symposium on Fission Product Release and Transport under Accident Conditions, Oak Ridge, Tenn.

Results of a series of five runs in which stable iodine plus ^{131}I tracer was released into an air-filled 1350-ft^3 model containment vessel are reported. The iodine concentration and form were observed over periods of 24 to 48 hr. In two runs, the iodine was released from NaI packed into hollow UO_2 cylinders by melting with a plasma torch in an air atmosphere. In two others, it was released from crystalline I_2 contained in a pyrex ampoule by melting the ampoule with the plasma torch. In the fifth run, iodine release was effected by heating the furnace to 98°C and breaking an ampoule containing crystalline I_2. Flowing helium transported the iodine into the model containment vessel. Iodine material balances were attempted in all runs, and the amount of iodine accounted for ranged from 50 to 80% of that initially present. Purging losses were suspected as one important contributing factor in the low iodine recovery, and provisions to account for these were added. Significant conversion of the airborne iodine to forms other than I_2 was observed. As much as 40% of the airborne iodine penetrated silver-plated screens, a 0.5-μ pore diameter membrane filter, and three layers of charcoal-impregnated fiberglass filter paper and was collected on activated-charcoal beds. Presumably, this material was CH_3I. A second compound form was observed that was collected slowly by silver, but more rapidly by rubber, and which was quantitatively removed by charcoal-impregnated filter paper. There is no accepted identification of this form. The airborne iodine concentration was reduced by factors ranging from 4 to 40. The least reduction occurred in the runs where I_2 was released by melting the pyrex ampoule with the plasma torch, and the greatest reduction occurred in the run in which I_2 was released by breaking the ampoule. This suggests that the aerosol produced by the torch may affect the iodine behavior. However, there is no correlation between the iodine release mechanism and particle behavior. At most, 1% of the iodine appears to be associated with particles. Preliminary results of theoretical studies on diffusion in a spherical vessel are reported. These indicate qualitative agreement with the observed time-dependent behavior. (auth)

34408 (ORNL-P-1313) AEROSOL PHYSICS OF RADIOACTIVE PARTICLES. Fish, B. R.; Walker, R. L. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 18p. (CONF-650407-4). Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

From International Symposium on Fission Product Release and Transport under Accident Conditions, Oak Ridge, Tenn.

The extent to which the behavior of radioactive aerosols differs from that of nonradioactive aerosols has not been clearly established. Such information is potentially of importance with respect to transport, deposition, resuspension, and filtration of fission product aerosols released in a reactor accident. Theoretically, electrostatic charging of the particles and of ungrounded surfaces, ionization of the gaseous environment, and surface effects, such as desorption of gases, can have a direct bearing on the properties of radioactive particles. Studies of the behavior of radioactive aerosols produced by exploding wires suggest that properties which depend on the presence of asymmetry in the distribution of electrostatic charge are modified by the enhanced conductivity of the air. Thus, in a low radiation environment, aerosols bearing a unipolar charge are deposited more rapidly in a container, because of space charge effects, than are radioactive aerosols of conductive particles which tend to lose an asymmetry of charge at a faster rate. In principle, nonconductive radioactive particles can accumulate a net unipolar charge which can increase their deposition rate; however, both high specific

activity and extremely low conductivity are required to produce a significant effect. Concurrent studies on the adhesion of radioactive particles to other particles or to surfaces indicate that, depending upon conductivity and upon the radiation properties of the materials involved, the effect of unipolar charge is to decrease adhesion between radioactive nonconductor particles, but to increase deposition and adhesion on irradiated dielectric surfaces. (auth)

34409 (ORNL-P-1324) BEHAVIOR OF RADIOIODINE IN THE CONTAINMENT MOCKUP FACILITY. Parker, G. W.; Martin, W. J.; Creek, G. E.; Barton, C. J. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 29p. (CONF-650407-6) Dep.(mn); $2.00(cy), 1(mn) CFSTI.

From International Symposium on Fission Product Release and Transport under Accident Conditions, Oak Ridge, Tenn.

A description is given of the Containment Mockup Facility which was used to study the behavior of ^{131}I released from clad UO_2 fuel elements. Results are given of runs made in air, air–steam, and air–steam containing organics. Deposition of ^{131}I on various surfaces was studied in these runs. The distributions of iodine in the composite filters are discussed. Melting and oxidizing tests were carried out on simulated UO_2 fuel, and the results are compared with these for irradiated UO_2. Results are also reported on the behavior of ^{131}I-labeled methyl iodide. (D.L.C.)

34410 HUMAN BODY INFLUENCE ON QUANTUM RAY MEASUREMENT. Tschirf, E. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 10: 229-32(May-June 1965). (In German)

An investigation was made of the effect of human body absorption and scattering of quantum rays relative to personal dosimetry. It is shown that possibly there are very high differences between the measured dose near the body and the irradiation dose in air at the same place. (auth)

34411 THE MAXIMUM PERMISSIBLE ACTIVITY CONTAINED IN THE EXHAUST AIR FROM A NUCLEAR PLANT. [PART] II. Koenig, L. A.; Zehme, S. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Atompraxis, 11: 268-70(May 1965). (In German)

A method for calculating the limits of the permissible amount of activity discharged from a nuclear plant is presented. A distinction is made between continuous and short-term discharge. For particularly important radionuclides, the limits were calculated on the basis of the recommendations of the (German) First Radiation-Protection Ordinance (1. SSVO) and of the ICRP, respectively. (auth)

34412 RADIUM D IN BONES, HAIR, AND LYMPH NODES OF URANIUM MINERS. Jaworowski, Z. S. (Inst. of Nuclear Research, Warsaw). Atompraxis, 11: 271-3(May 1965).

Radium D was determined in bones, hair, and lymph nodes of three uranium miners. The concentrations of RaD in bone ranged from 0.07 to 1.20 pC/g wet bone and in hair from 0.225 to 1.51 pC/g hair. The concentrations of RaD in bones were found to be dependent on long term exposure of the miners contrary to RaD content in hair, which depends rather on short-term exposure. High content of RaD in lymph nodes suggests that in uranium miners this tissue is a critical organ for this nuclide. (auth)

34413 PUBLIC HEALTH REPORT. Merrill, Malcolm H. (State Dept. of Public Health, Sacramento, Calif.). Calif. Med., 101: 138(Aug. 1964).

Brief reports are given on the State of California's programs of surveillance of medical radiation sources and fallout fission products in food. A regular biennial renewal of all radiation source registrations is provided for by the California Radiation Control Regulations. Since 1960, all users of radiation machines and certain radioactive material users have been required to register with the Department. The registration requirement now covers radiographic, fluoroscopic, and therapeutic x-ray equipment used by physicians and surgeons. As of March, 1964, there were 13,225 registered radiation source possessors, reporting 20,060 radiation machines. Of these 7191 were used for medical radiography and 3019 for medical fluoroscopy. There were 771 medical therapy units. Routine testing of food samples collected from hospitals in every area in California is part of the health department's radiological surveillance program. The food sampling program, coupled with air, water, and rain surveillance, provides comprehensive measurement of human exposure from environmental radioactivity. It was decided to obtain information on radioactive contamination of food consumed by people as representing the best index of public health concern with environmental radioactivity. The diets of hospitals was selected because at least one hospital exists in each area of interest, they are in operation every day, and a hospital diet is considered to represent a reasonable cross-section of food consumed in its community. It is recognized that wide variations exist in dietary habits and that there is no really typical diet. Nevertheless, the plan chosen is believed to be a reasonable one from the standpoint of determining overall population exposure from environmental radioactivity. Once every two months each hospital which agreed to cooperate sets aside a standard portion of each of 21 consecutive meals. These are frozen and shipped to the department's radiological laboratory to be analyzed. The results are reported in picocuries of ^{90}Sr, ^{137}Cs, and ^{226}Ra. (BBB)

34414 DEFINITION OF THE RADIATION COMPLEX. B. THE SOURCES OF RADIATION ACCIDENTS. Brucer, Marshall. Conn. Med., 28: 181-91(Mar. 1964).

Radiation accidents resulting from operation of accelerators and reactors are reviewed. Reactor operations which may contribute to accidental radiation exposure are explained, and construction and classification of reactors are described. A brief summary is given of all known serious incidents and accidents which have resulted from reactor operations. The first reactor accident, which did not really involve the reactor itself, occurred in Canada where one of the first reactors was installed. The reactor waste, kept in a large tank off the ground, tipped over and some of the highly active wastes were spilled out. There was some traumatic injury that demanded hospitalization and the entire area (including the hospital) was contaminated by people walking through the active wastes. Fifteen years later, a fuel rod ruptured in one of the Windscale reactors on the west coast of England, and a large amount of radioactive effluent discharged through the stack. The major portion was radioactive particulates of ^{106}Ru, ^{144}Ce, ^{95}Zr, and ^{95}Nd. There was a contamination of a large area of the Irish Sea, particularly the sea bottom, and about 400 square miles of land was contaminated with measurable amounts of activity. When the Spert (Special Power Excursion Reactor Test) reactor program was begun in 1954 at the National Reactor Testing Station in Idaho, the first deliberate runaway resulted in a mild muffled explosion, was completely contained within its own substance, and automatically shut itself off. Two accidents occurred in August 1945 and May 1946, which weren't really reactor accidents. Two scientists were experimenting with critical assemblies composed of a core of fissionable materials surrounded by shielding material. In all, ten persons received appreciable radiation, and two died, one on the ninth and one on the 24th day. In June 1952, four persons were in one of the reactor rooms in Argonne when the reactor was started up by mistake, but no symptoms or signs referrable to radiation occurred. Probably in 1953, two persons were exposed to neutrons and γ rays from a short general external exposure because of a reactor accident in the USSR. On October 15, 1958, six students were exposed while working with an experimental zero-power training reactor in Yugoslavia, when the amount of heavy water in this natural uranium heterogeneous reactor was abnormally increased. On January 3, 1961, three armed forces men were killed while working with the SL-1 (Stationary Low Power Reactor No. 1) at Idaho Falls, reconnecting the rod extension shafts in a reactor that had been shut down. There have been a few other purely reactor accidents. Usually they

are not the fault of the machinery nor of human operating error. Accidents involving material processed for reactors are also enumerated. Isotope accidents unrelated to reactors are also described. (BBB)

34415 MICROBIOLOGICAL ASPECTS OF THE FIXED-BED PROCESS FOR REMOVAL OF CATIONIC RADIONUCLIDES FROM MILK. Brazis, A. R.; Reyes, A.L.; Read, R. B., Jr.; Black, L. A. (Robert A. Taft Sanitary Engineering Center, Cincinnati). J. Dairy Sci., 48: 306-13(Mar.1965).

The nature of the fixed-bed cationic radionuclide removal process makes it advantageous to store the resin in the column in a wet condition between milk runs. This study showed that the wet resin supported rapid growth of bacteria, yeasts, and molds, and therefore, a need for sanitizing agents for treating ion-exchange resin and regenerant solution. Elemental iodine, iodophor, chloramine-T, chlormelamine, hydrogen peroxide, heat, and hydrochloric acid, alone and in some combinations, were tested for microbial control in the resin and in regenerant solutions. Column storage at pH 2 with a 170°F water rinse fortnightly was most effective for maintaining the resin in a sanitary condition, whereas adjustment to pH 2 with fortnightly additions of H_2O_2 controlled microbial growth in the regenerant solution. Microbial growth in milk during processing at flow rates of 0.125 and 0.250 resin bed volumes per min (rbv/min) was controlled by minimizing the time milk was held above 40°F; however, a flow rate of 0.0625 rbv/min (8-hr processing time) permitted substantial growth in milk held at a resin column temperature of 48 to 52°F after 4 hr of column use. The procedures developed for sanitary treatment of resin and regenerant solution did not affect the flavor of treated milk. Enterotoxigenic staphylococci inoculated into milk prior to processing at a flow rate of 0.0625 rbv/min did not produce detectable levels of enterotoxin A during 8 hr of milk processing. With relation to the Sr removal data, which showed that the 0.125 rbv/min milk flow rate was more efficient, and considering the microbiological problems for the three milk flow rates studied, a flow rate of 0.125 rbv/min appears to offer good microbial control, with reasonably efficient cationic radionuclide removal. (BBB)

34416 CHARACTERIZATION AND EVALUATION OF PUBLIC HEALTH IMPORTANCE OF EXISTING SOURCES OF IONIZING RADIATIONS IN BOSNIA AND HERZEGOVINA. Zarkovic, G.; Lucic, D. (Medical Faculty, Sarajevo, Yugoslavia). Med. Arkiv (Sarajeva), 18: 17-21(1964).

Data are presented on the existing number of sources of ionizing radiations in Bosnia and Herzegovina, classified as radioisotopes used in industry, medicine, and research institutes, and x-ray machines classified by age of production and producer. At the present time the health institutions and especially the outpatient departments (health centers) using diagnostic and dental x-ray machines are the most important places where a reduction in unnecessary exposures of health workers and the general public might be possible. (Excerpta Med.)

34417 THE STRONTIUM-90 CONTENT OF CANADIAN TOBACCO SAMPLES. Brown, John R.; Jarvis, Anita A. (Univ. of Toronto). Med. Serv. J. Can., 20: 613-15(July-Aug. 1964).

Radioassays were made on samples of processed tobacco leaves of Canadian origin from the 1960 and 1961 crops obtained from the Imperial Tobacco Company of Canada, Limited. The 1960 samples were pooled from material obtained throughout the growing season. The 1961 samples were separated with respect to their relative position in the growing plant (top, middle, and bottom parts). For analysis the skeleton of the leaves (midrib) was separated from the blade of the leaf (the lamina). Calcium determinations were also carried out. Strontium-90 values were expressed as $\mu\mu$C ^{90}Sr/g of ash and as $\mu\mu$C ^{90}Sr/g of Ca (S.U.). No ^{89}Sr was found in any of the samples examined. Both the ^{90}Sr and Ca contents of the lamina were greater than those of the midrib obtained from the same area of the plant. The average ^{90}Sr content per g of ash from pooled samples of midrib and lamina were 6.96 and 12.40 $\mu\mu$C, and the Ca concentration was 0.108 and 0.235 g per g of ash, respectively. The results indicate that there is about twice as much ^{90}Sr in the lamina as in the midrib of the tobacco plant in the samples analyzed. The average values of ^{90}Sr/g of Ca for the midrib, however, were somewhat higher than that for the lamina, 69.00 and 52.78 S.U., respectively, but the lower Ca content of the midrib may have accounted for this higher S.U. ratio. (TCO)

34418 UPTAKE OF CAESIUM-137, DUE TO NUCLEAR WEAPON FALL-OUT, IN SUBJECTS FROM WEST CUMBERLAND. Hesp, R. (United Kingdom Atomic Energy Authority, Windscale Works, Sellafield, Cumb., Eng. and Calder Works, Calderbridge, Cumb., Eng.). Nature, 206: 1213-15(June 19, 1965).

Measurements of the amount of fallout ^{137}Cs in the body were made on a small group of adult subjects who are residents of West Cumberland and are employed by the AEA on work that does not involve contact with radioactive material. ^{137}Cs enters their bodies via the diet, and since milk is considered to be one of the main sources, the relation between ^{137}Cs in milk, and that measured in the body, was also investigated. From its minimum value during the first quarter of 1962, the mean amount of ^{137}Cs in the body increased by a factor of about 6 by early 1964. During 1961, 1962, and 1963, the mean whole-body radiation doses received by male adults in West Cumberland were 1.4, 1.5, and 3.9 mR, respectively, and almost 6.0 mR in 1964. On the average, the radiation doses received by adult females from West Cumberland, were about 29% less than the doses received by adult males from the same area. (P.C.H.)

34419 CONTAINERS UNDER FIRE. HARWELL RATIONALIZES RANGE OF CLASS B TRANSPORT CONTAINERS. Nucl. Eng., 10: 234-5(June 1965).

Fire tests were carried out on class B transport container. The fire was provided by 10,000 gallons of jet fuel and burned for one hour at a temperature of 2000°C. A discussion of the requirements of shielding and shielding materials for irradiated fuels is given with special attention to thermal shielding. (J.F.P.)

34420 SAFETY IN CHEMICAL PROCESSING. Reactor Fuel Process., 8: 133-6(Spring 1965).

A description is given of the criticality incident which occurred on July 24, 1964, at a United Nuclear Corp. plant for recovery of enriched U from wastes and scraps. The operations prior to the incident and the events succeeding the incident are described. Recommendations of a review committee are given. A fire which occurred on Oct. 1, 1964 at Savannah River Plant is also described. The fire involved an anion exchange column used for the recovery of Np from Purex waste. The equipping of anion exchangers in the future to prevent such incidents is described. (D.L.C.)

34421 TESTING OF THE SEAL OF CONTAINERS FOR RADIOACTIVE SUBSTANCES AND ITS RESULTS. Koerner, H. J. (Gewerbeaufsichtsverwalt. des Landes Hessen, Kassel, Ger.). Zentr. Arbeitsmed. Arbeitsschutz, 14: 210-12(1964).

Results of measurements of leaks in sealed radioactive sources are discussed. The relative number of the leaking sources varied from 1.8 to 3.1 per cent of the number of sources investigated, of which 70 per cent were radium sources for therapeutic use. Some precautions are pointed out which would decrease the risk of spreading contamination from leaking sources. (Excerpta Med.)

34422 KSO PLUTONIUM SHIPPING CONTAINERS (Engineering Materials). (Rocky Flats Plant, Dow Chemical Co., Denver). 5 drawings. (CAPE-1200)

Two containers are described. The first type consists of a 30 gal, 27½ in. high drum, fabricated of 18 gauge steel, with a removable head. An inner container, which holds the materials being shipped, is 15 in. long and 4¾ in. OD with a wall thickness of 3/16 in. The inside wall of the inner container is fabricated of 99.9% pure Cd which is bonded to an outer galvanized steel wall. The second type container is also a 30 gal drum, 29⅛ in. high, with a welded sleeve 5¾ in. ID, and a locking lid. Laminated white oak is used for insulation. (For details, see TID-4100). (P.C.H.)

INSTRUMENTATION

General

34423 (AD-612538) APPLIED RESEARCH ON COUPLING SCHEMES FOR PLASMA AMPLIFIERS. Final Engineering Report, October 1, 1963–November 30, 1964. Chorney, Paul (Microwave Associates, Inc., Burlington, Mass.). Mar. 8, 1965. Contract AF33(615)-1110. 117p. (AFAL-TR-65-53) $4.00(CFSTI).

The concept of gap coupling to a beam-plasma system is studied. The theory of space-charge waves on one-dimensional beam-plasma systems is reviewed. The kinetic power associated with the complex waves of the system is examined, and it is proved that power can be extracted from the system even though the individual space-charge waves can carry no power. The action of an applied field on the space-charge waves is examined, and expressions for coupling coefficients are obtained. Computations of the coefficients predict that strong coupling can be obtained with long transit-angle gaps because of the complex waves. The problem of gap coupling to a beam-plasma waveguide is treated by a Fourier analysis, with the result that expressions are obtained for the coupling to each of the modes. X-band experiments are described on 3 study vehicles, each containing 2 plasma gap couplers and 2 re-entrant cavities as standard references. The presence of the plasma enhances the transmission of signals between the various parts of the study vehicles. The beam should be located close to the gap, but the gap width can be very long in terms of transit angle. Work is described on a feed system based on the quasi-optical properties of an ellipse. (CFSTI)

34424 (BNWL-SA-62) A SLIDING-SHAFT VACUUM LOCK FOR A MASS SPECTROMETER. Stoffels, J. J.; Lagergren, C. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 19, 1965. Contract AT(45-1)-1830. 13p. (CONF-650519-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI

From 13th Annual Conference of American Society of Testing Material Committee E-14, St. Louis, Mo.

An alumina vacuum lock is described which effectively eliminates seizing of the sliding surfaces. What might be considered a disadvantage with alumina parts is that they cannot be fabricated in the average machine shop, even one extensively equipped. Parts must be procured to specifications from vendors specializing in ceramic materials. The cost is several times greater than the cost of the equivalent item constructed of chrome-plated stainless steel. However, in practice, the analytical time lost in restoring the chrome-plated lock to service has far exceeded in value this initial cost differential. (auth)

34425 (HW-84384(p.7.1-27)) INSTRUMENTATION AND NONDESTRUCTIVE TESTING. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Research is reported on fuel rupture monitoring systems, gamma scanning fuel burnup measurements, regenerating neutron flux detectors, microwave neutron flux monitors, and boron-11 neutron detectors. Development of electromagnetic and thermal nondestructive test methods is described along with ultrasonic transducer research, ultrasonic imaging studies, and development of fatigue detection methods. (J.R.D.)

34426 (LNF-65/2) PROGETTO DI UNA SPARK-GAP PRESSURIZZATA. (Design of a Pressurized Spark Gap). Note No. 268. Cerioni, L.; Losciale, F.; Ubaldini, G. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Jan. 26, 1965. 12p. Dep.(mn).

The design, construction, and operational behavior of a pressurized spark-gap with small dimensions, good resistance of the electrodes, and small delay are presented. The forming circuit for the trigger pulse is also given. (J.S.R.)

34427 (NP-tr-1232) ON THE PICTURES OF MAGNETIZATION STRUCTURES OBTAINED WITH THE FARADAY AND KERR EFFECTS. Lambeck, M. Translated by G. T. M. Schlesinger (Atomic Energy Research Establishment, Harwell, Eng.), from Z. Physik, 179: 161-81(1964). 26p. Dep.(mn); $2.60(fs); $0.98(mf) JCL.

Ferromagnetic domains were observed by means of the Faraday and Kerr effects using the bright field as well as the one-sided, real symmetric and rigorous dark field method. By these experiments it is demonstrated that the light which is diffracted by magnetic domains is polarized perpendicular to the incident wave and that magnetic structures can be observed without any polarizer or analyzer. Applications of these diffraction phenomena and the consequences for the resolving power of magneto-optic microscopy are discussed. Magneto-optic pictures must be interpreted carefully to avoid erroneous results especially concerning the observation of domain walls. (auth)

34428 GAUGE FOR THE MEASUREMENT OF THE NICKEL PLATING ON URANIUM. Godward, D. F. (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). Brit. J. Non-Destructive Testing, 7: 11-12; 17-22(Mar. 1965).

The equipment needed for the measurement of the nickel plating thickness is described. The beta radiation emitted by the uranium-238 is used, and the detector is a halogen-quenched Geiger-tube. Thickness range covered is from 0 to 10 mils with achieved accuracies of better than ±0.25 mil over the entire range. (auth)

34429 PULSE FREQUENCY NMR (NUCLEAR MAGNETIC RESONANCE) FLOW METER. Ekaterinin, V. V.; Zhernovoi, A. I.; Stakhov, O. V. Izmeritel. Tekhn., No. 3, 54-6(Mar. 1965). (In Russian)

Non-contact apparatus based on the principle of nuclear magnetic resonance was developed for measuring the flow rate of active media. The liquid whose rate is to be measured flows through a pipe that goes through a polarizer, demagnetizer, and analyzer. The polarizer is a strong magnet, in the field of which the total magnetic moment of the nuclei of the liquid is developed. Switching on of the demagnetizer, which is a radiofrequency coil wrapped around the pipe and connected to a generator adjusted to the frequency of the movement of the nuclei, demagnetizes the system. The analyzer is a nuclear resonance flow type data unit. Its coil, also around the pipe, is in a magnetic field and is connected to the detector. When the liquid is polarized, the signal is recorded. A detailed diagram of the electronic unit is shown. The apparatus has been used for measuring flow rates in the range 0.08 to 1.4×10^{-5} m³/sec of water, acetone, and other liquids. The error does not exceed 1%. The unit may be used for measuring flows of liquids that give a NMR signal and have a nuclear relaxation time of not less than 0.1 sec. (TTT)

34430 A POLAR FLYING SPOT SCANNER FOR THE MEASURMENT OF BUBBLE CHAMBER PHOTOGRAPHS. Robinson, C. J.; Duff, M. J. B. (London Univ.). Nucl. Instr. Methods, 35: 1-12(1965).

An intermediate-speed prototype device for the measurement of bubble chamber photographs is described, including the principles of operation with respect to both electronic and theoretical considerations. Results obtained for selected film samples are compared with theoretical values. (D.C.W.)

34431 MULTIPURPOSE NEUTRON-DIFFRACTION INSTRUMENTATIONS. Atoji, M. (Argonne National Lab. Ill.). Nucl. Instr. Methods, 35: 13-33(1965).

An automatic double-crystal neutron diffractometer designed for both crystal and magnetic structure analyses at temperatures of 1.6 to 1700°C, with or without a magnetic field of up to 18 kgauss, is described, together with auxiliary instrumentation including the control electronics.

diffraction magnet, cryogenic equipment, and furnaces. (D.C.W.)

34432 DETERMINATION OF THE PROPERTIES OF DELAY-LINE COAXIAL CABLES. Mruk, W. F. (Oak Ridge National Lab., Tenn.). Nucl. Instr. Methods, 35: 61-6(1965). (ORNL-P-702)

An extension to a coaxial cable time-delay calibration technique is presented. The technique yields sub-nanosecond precision for values of cable delay times and provides simple measurements of cable attenuation and dispersion. The influences of cable attenuation and dispersion on machine time are described. (auth)

34433 A SIMPLE ZERO CROSSING DISCRIMINATOR. Alston, W. J.; Draper, J. E. (Yale Univ., New Haven). Nucl. Instr. Methods, 35: 155-7(1965).

A zero-crossing discriminator is described in which a low-capacitance tunnel diode is used, the quiescent current of which is slightly above the designated regenerative point. (D.C.W.)

34434 STUDY ON THE FACING-COUPLED ESAKI DIODE PAIR. Murata, Y. (Musashi Inst. of Tech., Ohzenji, Japan). Nucl. Instr. Methods, 35: 158-60(1965).

An analysis of the characteristics of the facing-coupled Esaki-diode pair circuit is summarized. The memory and switching actions of the circuit are demonstrated. (D.C.W.)

34435 MODIFICATION OF THE LABEN 512-CHANNEL ANALYSER FOR MULTIPARAMETER EXPERIMENTS. Gangas, N.; Katselis, V.; Kossionides, S. (Atomic Energy Commission, Athens). Nucl. Instr. Methods, 35: 163-4 (1965).

A modification of the Laben 512 analyzer to provide more than the 512 available channels for XY analysis is discussed. The resulting analyzer provides a matrix of 256 × 256 channels with a storage capacity limited to 512 events. (D.C.W.)

34436 A FAST METHOD TO DETERMINE THE TRAJECTORY OF CHARGED PARTICLES. Ozaki, S. (Osaka City Univ.). Nucl. Instr. Methods, 35: 169-70(1965).

A technique for recording the trajectories of charged particles in digitized form within a few μsec is described with which a spatial resolution of 1mm can be obtained. Systems for following single and multiple particles are outlined. (D.C.W.)

34437 PULSE SPECTRA OF A SINGLE PHOTOELECTRON. I. APPLICATION TO A STUDY OF THE ORIGIN OF BACKGROUND NOISE OF A PHOTOMULTIPLIER. Duquesne, M.; Tatischeff, I. (Institut du Radium, Paris). Nucl. Instr. Methods, 35: 181-93(Aug. 1965). (In French)

The amplitude distributions of single photoelectron pulses in photomultipliers were investigated. Differences between the amplitude distributions for signal and background noise were noted, on the basis of which hypotheses for the origin of the noise were proposed. The hypotheses were verified by experimental observations on background noise. (D.C.W.)

34438 MEASUREMENT OF THE THICKNESS OF THIN FOILS. Farouk, M. A.; Nassef, M. H.; El-Behay, A. Z.; Zaloubvsky, I. I. (Atomic Energy Establishment, Cairo). Nucl. Instr. Methods, 35: 210-12(Aug. 1965).

An instrument and method for the determination of foil thicknesses between 0.5 and 5.0 mg/cm^2 are described in which the relation between the energy losses by alpha particles passing through a foil and the foil thickness is used. Calibration curves for Al, Cr, Ni, and Sn are included. The accuracy of the method is better than 10%. (D.C.W.)

34439 A PRECISE 36 cm SCATTERING CHAMBER OF MULTIPLE POSSIBILITIES. Delaunay, B.; Delaunay, J.; Meurgues, J. P.; Passerieux, J. P. (Centre d'Etudes Nucleaires, Saclay, France). Nucl. Instr. Methods, 35: 245-9 (Aug. 1965). (In French)

An apparatus constructed for experiments in nuclear physics at the Saclay tandem accelerator is described. The apparatus provides the following features: rotation about the vertical axis of one of eight targets on a rotating wheel; rotation about the vertical axis of a circular tray supporting the detectors and measurement of the angle to better than 0.1°; reduction of the beam by steps of 0.02 mm using four slits followed by an anti-scattering tube; precise remote control of all functions; and precise remote display on dials of all angles and positions. (D.C.W.)

34440 A DIGITIZED MICROSCOPE FOR SCANNING NUCLEAR RESEARCH EMULSIONS. Benjamin, P. W.; Nicholls, G. S. (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 35: 283-9(Aug. 1965).

A digitized microscope for plate scanning in the measurement of neutron energy spectra in reactors by the emulsion technique is described, together with the scanning procedure and data analysis. A typical spectrum obtained in the core of the fast reactor VERA is included. (D.C.W.)

34441 A "LEAKY" INTEGRATOR CIRCUIT WITH AUTOMATIC SWITCHING. Birch, D. T.; Nelson, J. W. (Florida State Univ., Tallahassee). Nucl. Instr. Methods, 35: 293-300(Aug. 1965).

An electromechanical system for cross section and excitation curve measurements by counting residual radioactivity is described. The principle of operation of the leaky integrator is discussed. The circuits are described in detail, and examples of experiments performed with the aid of the equipment are given. (auth)

34442 A HIGH SENSITIVITY MAGNETOMETER WITH APPLICATIONS IN NUCLEAR MAGNETIC SPECTROSCOPY. Ringhiopol, I. (Institut de Physique Atomique, Bucharest). Nucl. Instr. Methods, 35: 309-12(Aug. 1965). (In French)

A magnetometer that is particularly suitable for fields of 0 to 400 gauss is described. The probe uses cores of highly permeable ferromagnetic material in glass tubes on which the excitation and measurement coils are wound and has a sensitivity threshold of 10^{-5} gauss. The device can be used for relative measurements of magnetic fields and for stabilization of field intensity. (D.C.W.)

34443 A HIGH STABILITY AMPLIFIER FOR NUCLEAR PHYSICS APPLICATIONS. Collinge, B.; West, C.; Lloyd, G. H. (Liverpool Univ.). Nucl. Instr. Methods, 35: 313-16(Aug. 1965).

A transistorized amplifier is described in which the techniques developed for value amplifiers are used. The amplifier has outstanding gain stability and good linearity and overload properties. (D.C.W.)

34444 CHART RECORDING UNIT FOR FAST RECORDING OF PULSE AMPLITUDE DISTRIBUTION OBTAINED FROM 100-CHANNEL ANALYZER AI-100-I TYPE. Dabek, Tadeusz; Korbel, Kazimierz (Inst. of Nuclear Tech., Krakow and Inst of Nuclear Research, Krakow). Nukleonika, 10: 131-2(1965). (In Polish)

A chart recording unit was designed that can read out and plot the contents of a 100 channel analyzer (type AI-100-1) in two minutes. It was required for gamma spectroscopy involving relatively short decay times. The modes and principles of operation and the circuit diagram are presented. The print-out accuracy is about 1% on the vertical scale. (TTT)

34445 GENERAL PURPOSE COUNTING UNIT. Mielnicki, J. Andrzej (Inst. of Nuclear Physics, Krakow). Nukleonika, 10: 132-4(1965). (In Polish)

The counting unit consists of a total of 70 decade-scaling units of which 10 are fast-scaling input units, 35 are slow-scaling units, 5 are rapid counting electromechanical registers and 20 are slow counting electromechanical registers. All seventy are mounted on a single chassis along with a common stabilized power supply. Interconnecting cables are located in the rear. These enable the counting system to perform a large variety of counting tasks. The tast-scaling units can count at a maximum rate of 100 kilocycles per second, the slow at 20 kilocycles per second, the fast electromechanical counters at 100 cycles per second and the slow electromechanical registers at 10 cycles per second. (TTT)

34446 GENERATOR OF RECTANGULAR PULSES. Nasibov, A. S.; Lomakin, V. L. (Inst. of Physics and Tech., Lukhumi, SSR). Pribory i Tekhn. Eksperim., No. 3, 120-2(May-June 1965). (In Russian)

A description is given of a rectangular voltage pulse generator with partial discharge of capacitance, in which a pulsed thyratron with controlled moment of quenching is used as commutating element. The generator allows voltage pulses with amplitude to 2 kv, with smoothly regulated duration from 20 to 1000 μsec, and with frequency of pulse tracking 50 cps to be obtained. The length of the pulse front is not more than 6 μsec, and the nonuniformity of the flat part <1%. (tr-auth)

34447 SELECTION OF OPTIMUM OPERATING CONDITIONS FOR OMEGATRON. Chmil, N. G. (Kiev Inst. of Semiconductors). Pribory i Tekhn. Eksperim., No. 3, 153-9(May-June 1965). (In Russian)

The optimum operating regime of the omegatron mass spectrometer for qualitative measurements is demonstrated on the basis of analysis of the operation of the apparatus. The analyzer, the circuitry, and the vacuum system are described. The variation of the ion current with the values of the variable and bias voltages for constant gas pressure and emission current is investigated. The motion of ions in a constant magnetic field in the presence of a variable electron field and bias voltage is studied. (M.J.T.)

34448 HIGH TEMPERATURE CELL COMPARTMENT FOR THE UNICAM SP 700 SPECTROPHOTOMETER. Bailey, R. A.; McIntyre, J. A. (Rensselaer Polytechnic Inst., Troy, N. Y.). Rev. Sci. Instr., 36: 968-70(July 1965).

A furnace which permits simultaneous heating of sample and reference compartments, and which can be readily installed or removed from the unmodified instrument, is described for the Unicam SP 700 spectrophotometer. A technique for preparing air sensitive melts is included. The spectrum of Nd^{+3} in the LiCl–KCl eutectic is shown to illustrate the performance of the instrument. (auth)

34449 HYDRAULIC CONSTANT-VELOCITY TRANSDUCER FOR MÖSSBAUER EFFECT MEASUREMENTS. Kocher, C. W. (Budd Co., Dowingtown, Penna.). Rev. Sci. Instr., 36: 1018-22(July 1965).

A hydraulic constant-velocity Mössbauer effect transducer is described which features low cost, low noise, and a high degree of precision and accuracy, using off-the-shelf components. This unit was designed and used as a research instrument, but because of its simplicity of construction and operation it could serve well as the basis for a demonstration unit for an undergraduate laboratory. The description includes specification of important components and block diagrams of the spectrometer. Results of Mössbauer effect measurements in Armco iron and some stainless steels are presented to show the performance of the instrument. (auth)

34450 AUTOMATIC ELECTROLYTIC TANK AND DIGITAL COMPUTER PROGRAM FOR CALCULATIONS OF ION TRAJECTORIES IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Reiser, Martin; Kopf, John (Michigan State Univ., East Lansing). Rev. Sci. Instr., 36: 1022-7(July 1965).

An automatic electrolytic tank facility and a digital computer program are described for studies of ion trajectories in a time-varying electric field with superimposed magnetic field. The electrolytic tank system features a probe, the motion of which is motor controlled to allow automatic measurements of electric fields in the form of two dimensional arrays of data points rather than equipotential lines. The voltage at each point of the rectangular grid is automatically balanced to ground by a self-balancing bridge and the value punched on an IBM card. The computer program is written in FORTRAN and integrates the relativistic equations of motion in Cartesian coordinates numerically by the Runga-Kutta method. The electric field is carried as a rectangular grid of potential values as obtained from the tank measurements. Magnetic field information is represented in the form of a Fourier series in azimuth, with average field and Fourier coefficients tabulated at radial increments. The program was written for orbit calculations in the center of a cyclotron, but it can be used or adapted for many other problems of charged particle motion in crossed electric and magnetic fields. (auth)

34451 GO-NO-GO GAUGE (Engineering Materials). (Lawrence Radiation Lab., Univ. of California, Berkeley). 3 drawings. (CAPE-1208)

The standard etched wiring board with 22 contacts is $4\frac{3}{8}$ in. × $4\frac{3}{16}$ in. A gauge was designed for a rapid dimensional check of the standard printed wiring board. The gauge checks the width of the board, the width, length, and location of the insertion tab, and the position of contacts. (For Details, See TID-4100). (M.C.G.)

34452 SPARK GAP TRIGGER AMPLIFIER (Engineering Materials). (Lawrence Radiation Lab., Univ. of California, Berkeley). Text and 73 drawings. (CAPE-1209)

The four-stage, nonlinear amplifier described is triggered by a 1-v signal, which provides, with minimum delay, an output pulse of sufficient energy to trigger several spark gaps. The output pulse produced by discharging a 1000 pF capacitance, charged to 10 kv into a load, has a rise time of 10 ns and begins 32 ± 4 ns after the application of the 1-v input pulse. The amplifier, while operating at an average repetition rate of 0 to 50 pps, can be triggered in pulse bursts with a minimum of 5 ms between pulses. Amplification is accomplished by avalanche transistors, a common-cathode planar triode, a grounded-grid planar triode, and a triggered spark gap. On application of an input trigger, the four stages are progressively pulsed into a highly conducting state producing the 10-kv output pulse. The spark-gap triggering amplifier is used with a pulse modulator, coincidence circuit, discriminators, detectors, and the spark chamber in studying particles. The amplifier section of the chassis contains the trigger amplifier, air spark gap, and high-voltage power supplies. The front-panel section contains the low-voltage power supply, and a 15-kc oscillator amplifier. (For Details, See TID-4100). (M.C.G.)

34453 CAMERA ROTOR AND SYNCHRONIZER, SIGNAL AMPLIFIER (Engineering Materials). (Lawrence Radiation Lab., Univ. of California, Livermore). 7 drawings. (CAPE-1254)

This unit is used with a generator and an amplifier with a camera. The synchronizer amplifier receives its input signal from the P. M. pickups, which are mounted on the camera housing. Sine waves or pulses of either polarity may be used for triggering with slight circuit adjustments. The transistorized amplifier has high impedance input. It has a 20–25 voltage gain and a screwdriver adjustment to provide for attenuating the input signal amplitude. The maximum input signal amplitude without overdriving the amplifier is 10 v. It requires a 12 v power supply. The +40 v input is dropped to 12 v by a Zener diode and its current limiting resistor dissipates ~4 w. For this reason a 10 w resistor is mounted on the box rather than on the P. C. board. (For Details, See TID-4100). (M.C.G.)

34454 FILAMENT PREPARATION PUMPING STATION (Engineering Materials). (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). 3 drawings. (CAPE-1224)

A vacuum chamber was designed for use in the preparation of filaments for a mass spectrometer, which is used to identify nuclides in reactor effluent streams. The 13.94-in.-long chamber was fabricated of stainless steel tubing 5-in. OD with a 0.120-in. wall thickness. The unit was He leak tested to ensure that the electrical terminal is vacuum tight to leaks as small as 3×10^{-10} ccps. (For Details, See TID-4100). (M.C.G.)

34455 PULSE GENERATOR, TRANSISTORIZED (Engineering Materials). (Lawrence Radiation Lab., Univ. of California, Livermore). 4 drawings. (CAPE-1252)

The generator described consists essentially of a tunnel diode, a discriminator input circuit, and a pulse-shaper output circuit. There are 4 transistors used in the circuit. The use intended for the unit was that of a camera syn-

chronizer, signal shaper, and amplifier. The generator functions on positive or negative input signals with a slight circuit modification. The input pulse is from 3 to 100 v with a minimum width of 0.5 μsec. The repetition rate extends to 100 kc. The sine-wave input is from 5 to 30 v (p-p) with a frequency of 100 c to 100 kc. With the output terminated in a 50 Ω load, the positive output pulse amplitude is greater than 30 v with a pulse width of 1 μsec and a rise time of 50 ns. The power requirement is +40 v d-c, and 150 ma. (For Details, See TID-4100). (M.C.G.)

34456 AMPLIFIER, TRANSISTORIZED (Engineering Materials). (Lawrence Radiation Lab., Univ. of California, Livermore). 4 drawings. (CAPE-1253)

The four-transistor amplifier described is used specifically with camera rotor speed pickups. The response is ±1 db for a frequency range of 30 c to 200 kc. The maximum output with negligible distortion is 6 to 7 v (p-p) into a 50 Ω load. The input impedance at 100 kc is ~20 k Ω and the minimum voltage gain is 20. The maximum input signal amplitude without overdriving the amplifier is 0.30 v (p-p). The power requirement, without the Zener diode using a bypass, is +12 v d-c, and 120 ma. If both a higher input voltage and the Zener diode are used, 10 to 20 ma additional current is needed. (For Details, See TID-4100). (M.C.G.)

34457 A TWO DIRECTIONAL FOCUSSING HIGH INTENSITY MASS-SPECTROMETER FOR PREPARATION OF ISOTOPIC TARGETS. Karmohapatro, S. B. (Saha Inst. of Nuclear Physics, Calcutta). 5p. (CONF-578-6). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

A two-directional focusing high-intensity mass spectrometer with the mean radius, 38 cm, focusing angle $\sqrt{2}\pi$ and the field index $n = \frac{1}{2}$ is described. Performance of the magnetic analyzer with a magnetic oscillation and sputtering ion source is studied along with the focusing properties of the magnetic analyzer. The field shape of the magnetic analyzer is given as $H_z = H_0[1 - (\gamma - \gamma_0/2\gamma) + (\gamma - \gamma_0/4\gamma)]$ by conical pole faces with $n = 2^0$, the angle of the surface to the symmetry plane, for a gap width slightly greater than 5 cm. Measurement of the field gradient shows that a small part of the pole faces satisfies the above field shape. The resolving power of the instrument is 125 with the peak current ~10^{-7} amp for Kr−84 at 8 kv accelerating voltage. Some operational characteristics of the ion source are described so that instrument may be useful for studies of collision processes and for preparation of isotopic targets. (auth)

34458 ON THE FISSION PARTICLE SPECTROGRAPH. Ewald, H.; Konecny, E.; Opower, H. (Technische Hochschule, Munich). 4p. (CONF-578-8). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

A description of the fission particle spectrograph is given. The spectrograph is intended to give a direct mass spectrum of fission particles coming out of thin sheets of ^{235}U with their high initial kinetic energies and with net charge states of about 20 to 25. The first well-resolved fission particle spectra were obtained. (J.F.P.)

34459 MAKE SWITCH FOR FAST ELECTRICAL DISCHARGE. Martin, John Christopher (to United Kingdom Atomic Energy Authority). British Patent 988,777. Apr. 14, 1965. Filed Jan. 9, 1962.

A make switch for establishing a conducting path between a pair of electrodes consists of solid dielectric material separating the electrodes. The material is provided with a channel extending from one electrode toward the other and terminating at a predetermined point within the material. The shape of the channel at the terminal point is adapted to increase electrical stress at the point when electrical stress is applied and produce electrical breakdown of the material. In a preferred form of the switch, the positive and negative electrodes are separated by an intermediate electrode held at an intermediate voltage. Pulses can be applied to the intermediate electrode to produce an overvoltage that causes breakdown. (A.G.W.)

34460 IMPROVEMENTS RELATING TO REMOTE INDICATING APPARATUS. McAllister, Lawrence Edward; Sherlock, James (to Associated Electrical Industries Ltd.). British Patent 994,776. June 10, 1965. Filed Jan. 26, 1962.

An electrical apparatus provides indication of the position of a body such as a control rod in a reactor. The apparatus includes means for generating a variable phase voltage having a phase determined by the positioning of the body within any one of successive sections of overall travel. A square wave form is generated in which the phase of one edge is controlled by the variable phase voltage, and the phase of the other edge is controlled by a constant phase reference voltage. Means responsive to the mark/space ratio of the square wave indicate the position of the body within the section of its travel, and means for counting the number of cycles of phase displacement described between the variable phase voltage and the reference phase voltage indicate the particular section of travel in which the body is located. (B.L.M.)

34461 ELECTRON PULSER FOR AN X-RAY TUBE TO PRODUCE A PULSED BEAM OF X-RAYS. Alfred J. Gale (to High Voltage Engineering Corp.). U. S. Patent 3,178,578. Apr. 13, 1965. Filed Mar. 3, 1961.

An x-ray device adapted to take a series of closely spaced pictures utilizes an electron accelerator designed for pulsed operation. In the electron accelerator, electrons are emitted and accelerated by known methods. After initial acceleration, the electron beam is deflected across an aperture at the low-velocity end of the acceleration tube in a controlled manner such that the frequency of deflection determines the interval between pulses and the amplitude of deflection, entrance aperture, and beam diameter in combination determine the duration of the individual pulses. A gating circuit may be added to limit the number of pulses. (A.G.W.)

34462 POSITIVE ION SOURCE. Eklund, Karl (to Radiation Dynamics, Inc.). U. S. Patent 3,178,604. Apr. 13, 1965. Filed Apr. 10, 1962.

In an ion source employing electrostatic and electromagnetic focusing of a plasma-producing electron beam, the magnets used to produce the magnetic focusing field are located externally of and are removable from the ion source. The unit is air-cooled and the discharge region may be viewed during operation. The apertures through various electrodes of the apparatus may be adjusted after assembly and during operation by machine screws located outside the device. The beam focusing and concentrating electrodes have replaceable inserts located in the regions of high temperature so that these portions of the electrodes may be readily replaced. (A.G.W.)

34463 APPARATUS USING CĚRENKOV RADIATION. Petroff, Michael D. (to National Engineering Science Co.). U. S. Patent 3,178,656. Apr. 13, 1965. Filed Feb. 14, 1961.

An apparatus for generating millimeter electromagnetic waves involves a high-voltage beam of bunched electrons passing through an aperture in a dielectric medium. The dielectric medium is disposed in an electrostatic structure, which provides a uniform electrostatic field and is charged at a sufficiently high electric potential to accelerate the electron beam to a high enough velocity immediately before entering the dielectric medium that the Cherenkov effect is realized during the time that the electrons drift through the dielectric medium. The electron beam collector, which collects the electrons after passage through the dielectric, is biased so that improved energy conversion efficiency results when used either as an amplifier or as an oscillator. (A.G.W.)

34464 COLLIMATOR SYSTEM FOR BETA RADIATION THICKNESS GAUGE SENSOR. Hansen, Carl Woodrow (to Lab. for Electronics). U. S. Patent 3,185,843. May 25, 1965. Filed June 20, 1961.

A collimator arrangement for a radioactive thickness gage sensor is provided in which the detector response remains substantially constant despite minor variations in the relative positions of source and detector. A single

hole collimator is placed in closed juxaposition to each of two radioactive sources emitting beta radiation. The sensitive face of the detector is provided with an absorber plate arranged to intercept a portion of the collimated beam from each source. The absorber plate is made of a material adapted to absorb most of the radiations impingent upon it and has a generally rectangular elongated opening with the longitudinal axis of the opening extending transverse of the axis of alignment of the sources. The rectangular opening is substantially centered on the center of the detection surface with one long edge of the opening intersecting the area irradiated by the first source and the other long edge of the opening intersecting the area irradiated by the second beam. (B.L.M.)

Radiation Detection

Refer also to abstracts 33738, 33739, 34066, 34068, 34099, 34922, 35231, 35378, 35476, and 35693.

34465 (AD-603666) SUPERCONDUCTING NUCLEAR PARTICLE DETECTOR. First Trimonthly Report, March 25, 1964–June 25, 1964. Spiel, D. E. (Atomics International, Canoga Park, Calif.). Contract DA-18-035-AMC-107(A). 34p. (AI-64-159). $2.00(CFSTI).

The design, construction, procurement, and testing of auxiliary equipment were carried out. Several films were manufactured, characterized, and subjected to alpha bombardment. During this irradiation, both propagating and nonpropagating pulses were observed. The amplitudes of these self-recovering pulses varied from 100 to 300 μv, nearly an order of magnitude larger than calculated. The pulse widths at half maximum were 20 nsec, the limit of the equipment. Critical current vs temperature data for several films are consistent with the results reported by others. (auth)

34466 (AD-612677) SUPERCONDUCTING NUCLEAR PARTICLE DETECTOR. Interim Report, March 25, 1964–February 15, 1965. Spiel, D. E.; Boom, R. W. (Atomics International, Canoga Park, Calif.). Contract DA18-035AMC107A. 62p. (AI-65-36) $3.00(CFSTI).

A summary is presented of work in which the application of superconducting thin films to nuclear particle detection was investigated. The main result is that superconducting particle detectors are feasible. Self-recovering, alpha-induced pulses of nsec duration were observed on a variety of tin films which had widths ranging from 10 to 50 microns. Considerable progress was made in understanding these and other observations by the development of a theory which is in good quantitative agreement with the experimental results. (CFSTI)

34467 (AD-613014) EFFECTS OF GAMMA RADIATION ON DIELECTRIC PROPERTIES OF POLYETHYLENE TEREPHTHALATE. Progress Report. Miscellaneous Paper No. NRL-MP-789. Campbell, F. J. (Naval Research Lab., Washington, D. C.). May 6, 1963. 26p. $2.00(CFSTI).

It is possible to observe the degradation of polyethylene terephthalate film as a function of radiation exposure through measured changes of dielectric properties. The induced conductivity of air at atmospheric pressure prohibits the use of exposed electrodes or bare wires in a system for conducting measurements in the radiation field. By utilizing a system of conductive silver paint electrodes, a guarded circuit, and encapsulation of all conductors and contacts, it was possible to conduct reliable measurements in the radiation field. However, with the polystyrene and other organic materials used in the specimen holder, it is not possible to monitor these measurements in the radiation field continuously or to conduct similar measurements at elevated temperatures. The decrease in background leakage currents at low ambient pressures encourages further study toward the development of a system for continuous measurement in radiation. (auth)

34468 (AECL-2252) γ-RAY DOSIMETRY WITH p-i-n JUNCTION COUNTERS. Jones, A. R. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Feb. 1965. 17p. Dep.; $0.50(AECL).

A manufacturing process was developed for low cost p-i-n junction counters, having 5 and 100 mm^2 junctions with intrinsic layer thickness of 1 mm. The performance of 20 samples as γ-ray dosimeters and the performance stability over a period of 19 months are described. In addition, suitable techniques and circuits to permit the application of these detectors to γ-ray dosimetry are discussed. (auth)

34469 (BNWL-62) AERIAL AND GROUND GAMMA SURVEY MONITORS. Philipp, L. D.; Sheen, E. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1965. Contract AT(45-1)-1830. 16p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Two sensitive, reliable gamma monitors were developed for aerial and ground survey of radiation at Hanford. The aerial monitor employs a 5-in.-dia by 3-in.-long NaI(Tl) crystal detector with the multiplier phototube capacity coupled to a solid state preamplifier. The electronic pulses are coupled to an amplifier in the main instrument via the same cable supplying power to the preamplifier. The multiplier phototube high voltage is supplied with a separate cable. For reliability and ruggedness, the preamplifier, main amplifier, discriminator, binaries, saturator, and count-rate circuit are all solid state. The instrument has five ranges from 10^4 counts/min to 10^6 counts/min. The aerial monitor can detect 0.1 μC of ^{131}Ba at 14 in. from the center of the detector and can detect a general ground contamination of about 0.4 $\mu C/m^2$ of ^{131}I from 500 ft above the ground, if the ^{131}I extends over an area approximately 2000 ft in diameter. The monitor for the detection of gamma-emitting radionuclides from moving ground vehicles employs a 5-in.-dia by 5-in.-long NE-102 plastic scintillator. The instrument circuits are essentially the same as in the aerial monitor, except for certain component values changes for the detector assembly. The minimum detection level for the ground monitor was 0.1 μC of ^{131}Ba at a distance of 13 in. from the center of the detector. (auth)

34470 (CEA-R-2765) APPLICATIONS D'UN COMPTEUR PROPORTIONNEL A QUELQUES CAS PARTICULIERS DE MESURES α. (Application of a Proportional Counter to Some Particular Cases of α Measurements). Ferret, Janine; Gasç, Marie-Therese; Le Du, Rene. (Commissariat à l'Énergie Atomique, Saclay France). Centre d'Études Nucléaires). Mar. 1965. 27p. Dep.(mn).

A measurement method based on α−γ coincidences is used for activity measurements on ^{241}Am in the presence of a strong α activity due to Pu. The sensitivity of the apparatus makes it possible to detect less than 10^{-7} μC ^{241}Am in the presence of α Pu activities several hundred times greater. The same equipment was used for α measurements on α-emitting sources in the presence of very strong β and γ activities. In particular results are given for α-activity measurements on powder samples. It is even possible in these conditions to detect or measure ^{241}Am. The equipment makes possible also: the absolute calibration of a pure ^{241}Am source, ^{237}Np measurements, simultaneous measurements of α, β, and γ activities in solid samples in solid samples in various forms. The assembly includes a small-size proportional counter operating in conjunction with a γ probe, together with auxiliary electronic equipment (stabilized high voltages, amplifiers, a coincidence unit, a scaler). (auth)

34471 (CERN-65-13) APPLICATION DES GUIDES DE LUMIERE A L'ECLAIRAGE DE MARQUES FIDUCIAIRES. (Application of Light Guides to the Illumination of Fiducial Markings). Banaigs, J.; Berger, J.; Moueellic, B. (European Organization for Nuclear Research, Geneva (Switzerland)). Mar. 20, 1965. 21p. Dep.(mn).

A large (2 m × 2 m) spark chamber having transparent wire-gauze electrodes is considered. In order to illuminate fiducial markings on the plexiglas spacers, a flash light source is designed. The source itself is set outside the spark chamber area, and the light is transmitted through a light pipe into the chamber when illumination is required.

Flash characteristics of the source are shown graphically. (T.F.H.)

34472 (CONF-758-25) THIN PARALLEL PLATE PROPORTIONAL COUNTER. Hilberg, R. H.; Draper, J. E.; Alston, W. J. III (Yale Univ., New Haven, Conn.). [nd]. Contract AT(30-1)-1807. 6p. Dep.(mn); $1.00(cy), 1(mn) CFSTI; Gmelin, AED-CONF-65-003-53.

From American Physical Society Meeting, New York, Jan. 1965.

In order to carry out a measurement of the proton polarization in the photodisintegration of beryllium and carbon, a detector was developed which combined the properties of 100% efficiency, fast resolving times, and uniformity of gain and timing over a large area. In addition, it was desired that these detectors be thinned to 5 Mev protons. A description of these detectors is presented. (M.O.W.)

34473 (IFA-CR-53) SEMI-AUTOMATIC MEAN GAP-LENGTH METER FOR IONISATION MEASUREMENTS. Bercea, C.; Ciuc, I.; Friedlaender, E. M.; Totia, H. (Institutul de Fizica Atomica, Academia R. P. R., Bucharest). Apr, 1965. 5p. Dep.(mn).

Assuming that above a certain minimum gap-length l_1 the distribution of gaps in particle tracks is exponential, a semi-automatic device was built yielding directly the average gap-length of gaps exceeding l_1 by means of a digitized eye-piece filar-micrometer. (auth)

34474 (INR-584/II/PS) BEAT-FREQUENCY METHOD FOR THE CAPACITANCE MEASUREMENT OF SEMICONDUCTOR NUCLEAR-PARTICLE DETECTORS. Przyborski, W. (Institute of Nuclear Research, Warsaw (Poland)). Dec. 1964. 15p. CFSTI.

Capacitance effects in semiconductor nuclear particle detectors, the principle of capacitance measurement methods, and the apparatus constructed are discussed briefly. Voltage-capacitance characteristics for the surface-barrier, thermal-diffused, and Li-ion-drifted detectors are presented. (auth)

34475 (INR-604/XIX/D) IZMERENIE POSTOYANNYKH VYSVECHIVANIYA MEDLENNOI KOMPONENTY STSINTILLYATSII ORGANICHESKIKH STSINTILLYATOROV. (Measurement of the Decay Rate of the Slow Component of Luminescence in Organic Scintillators). Pshona, Stanielav (Institute of Nuclear Research, Warsaw (Poland)). Feb. 1965. 12p.

The method of measuring the rate of decay of the slow component of luminescence in scintillators is described. Results for organic scintillators are presented. (auth)

34476 (IPP-1/32) ENTWICKLUNG EINES RONTGENSPEKTROMETERS UND DER ZUGEHORIGEN NACHWEISMETHODEN FUR WEICHE RONTGENSTRAHLEN. (Development of an X-Ray Spectrometer and the Appropriated Detectors for Soft X Rays). Kornherr, M. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Feb, 1965. 49p. Dep.(mn).

A spectrometer for soft x rays was developed, based on Bragg's law. The upper limit of the measurable wavelength is 24.1 Å. Both a gas-flow proportional counter and a plastic scintillator were used as detectors for the soft x rays. The wavelength dependence of various characteristics was investigated for these two detectors. The x ray spectrum emitted from the deuterium plasma of a theta pinch was studied with this diffraction spectrometer. Necessary corrections for the measured signal are given. (auth)

34477 (JINR-P-2146) NOVYI METOD UCHETA KULONOVSKOGO RASSEYANIYA PRI OBRABOTKE KAMERNYKH TREKOV. (A New Method of Account of Coulomb Scattering in an Analysis of Bubble Chamber Tracks). Gramenitskii, I. M.; Tikhonova, L. A.; Shlyapnikov, P. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 6p. Dep.(mn).

A correct method is considered of taking Coulomb scattering into account when determining the kinematic parameters of the bubble chamber tracks by the least-squares method. A functional is constructed in which the matrix of coordinate errors is introduced. This matrix takes into consideration the correlation of errors due to Coulomb scattering. Formulas are given for finding the parameters of the function approximating the track and their errors. (auth)

34478 (ORNL-TM-985) NANOSECOND LIGHT SOURCES FOR GAIN STABILIZATION. McConnell, J. W. (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 14p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Three fast light sources, a corona lamp, an argon lamp, and a high-pressure (190 mm Hg) neon lamp, were tested as possible sources for injecting a stable light pulse into a photomultiplier tube and thus stabilizing the entire photomultiplier system. The commercial corona lamps tested gave a nearly ideally shaped light pulse but were too unstable in light output for use as a standard source. The argon-lamp system showed good stability, but the light pulse has a long, low-amplitude tail which introduces difficulties in high-gain systems. The neon lamp appears to be the most promising source, preliminary tests showing a suitable pulse shape, output, and duration. The stability of the neon lamp was observed to be much better than that of the corona lamp, and tests are planned to determine whether it is superior to that of the argon lamp. (auth)

34479 APPLICATIONS OF AUTORADIOGRAPHIC METHOD IN STUDIES OF RADIOACTIVE AEROSOLS. Lavrenchik, V. N. At. Energ. (USSR), 18: 499-503 (May 1965). (In Russian)

An analysis was made of the process of formation of (10μ to a fraction of a micron) black spots in nuclear-sensitive emulsion from β and γ emitters. A graduating curve was constructed showing the relation between β activity and the size of black spots in native emulsions during 10 day exposure. A method was developed for measuring the distribution of the spots in the specimens of northern hemisphere fallout during Dec. 1962 and May 1963. It is shown that the distribution is hyperbolic in character with the tendency towards increasing the curve with time following the moment of fallout detection of radioactive aerosols into the stratosphere. (tr-auth)

34480 DISLOCATIONS AND NUCLEAR PARTICLE TRACKS IN SILVER CHLORIDE CRYSTALS. Childs, C. B.; Slifkin, L. M. (Univ. of North Carolina, Chapel Hill). Brit. J. Appl. Phys., 16: 771-7(June 1965).

Defects such as dislocations and the tracks left by energetic charged particles may be made visible inside large crystals of silver chloride by a photoelectric technique, the net result of which is the deposition of metallic silver along the imperfections. The main advantage of this procedure in the study of dislocations is that large regions of the crystal may be observed in the cold-worked state. For the study of cosmic rays and nuclear events, a convenient and distortion-free detector is offered which may be of use in specialized applications. (auth)

34481 THE MEASUREMENT OF EPITHERMAL NEUTRON CURRENTS BY USE OF INDIUM FOILS. Etherington, E. W. (United Power Co. Ltd., Heston, Middx., Eng.). Brit. J. Appl. Phys., 16: 885-8(June 1965).

A description is given of a detector, in the form of a sandwich of indium foils, which can be used to measure a current of epithermal neutrons. The detector has been tested by comparing measured currents with theoretical predictions and found to work satisfactorily. Experimental results of neutron current measurements made with the indium foil sandwich in a loaded fuel channel of an exponential assembly are presented. (auth)

34482 BEHAVIOR OF ORGANIC SCINTILLATOR UNDER HIGH VOLTAGE. Mitrani, L.; Boncev, C. Compt. Rend. Acad. Bulgare Sci., 16: 477-9(1963).

The effect of high voltage upon a stilbene and upon a plastic scintillator is studied. It is established that a field of the order 2 to 4×10^4 v/cm deforms gamma-ray spectra. (auth)

34483 A LARGE-VOLUME, GEOMETRY-INDEPENDENT SCINTILLATION COUNTER. Krasznai, Istvan; Farkas, Gyoergy; Gyergyanffy, Geza. Energia Atomtech., 18: 114-16(Feb.-Mar. 1965). (In Hungarian)

Medical and biological isotopic studies, such as ^{131}I-labeled triolein absorption, ^{131}I-labeled Bengal-red liver function test, determination of the isotopic concentration of feces, or the whole-body counting of small animals, require the accurate determination of large-volume, low specific-activity, nonhomogeneous radiation sources. Such measurements are preferably carried out with a geometry-independent counter, in order to be able to compare directly and without corrections the activities of the nonhomogeneous emitters. For this reason, a shielded, liquid-scintillator counter was designed and built; a solution of POPOP and paraterphenyl in toluene served as the scintillator. The outside surface of the double-wall glass container of the counter was coated with MgO in order to increase the light yield. The geometry-independent character of the counter was tested by determining the count rate of samples possessing identical activity but different volumes, by determining the changes in the count rate when the location of a point source was varied within the detector volume, and by comparing sources possessing varying shapes but identical volume. The results indicated that the system was geometry independent within 10%. The lowest detectable activity was 0.03 μC for ^{131}I, 0.02 μC for ^{60}Co, and 0.05 μC for ^{86}Rb at the 90% reliability limit at the customary measurement periods of 2 × 2 min. The instrument was found suitable for the whole-body counting of small laboratory animals. (TTT)

34484 π-μ COUNTER. Kimura, I. Genshiryoku Kogyo, 8: No. 1, 65-9(1963). (In Japanese)

When π^+ mesons are stopped by an absorber in a definite time interval a delaying coincidence occurs between the μ signal formed in decay and the π signal formed in absorption. For more efficient counting, the longer (~50 μsec) π signals are used; because of the coincidence of the π signal and the background noise, the background is counted by a delaying coincidence at a point distant from the π signal. In synchrotron experiments, because of the high electron background, an anticoincident Cherenkov counter is used in the system. A block diagram of such a counter is given. Coincidences from the background low-amplitude signals are decreased by discrimination at the signal entrance. For good μ-signal selection with π-μ delaying coincidence, a constant pulse height, corresponding to 4.15 Mev energy, is used. A photomultiplier with small saturation effect and negligible transfer time increase is used to separate the signals. Since the discriminator dead time increases with pulse energy of the π signals as an overload effect, preliminary coincidence with subsequent discrimination was used. The error was decreased by a very short gating-pulse rise time. Using the saturation effect in the transfer, pulses with rise times of 3 μsec and 20 to 80 μsec long were obtained. Characteristics of the counter system are: simplicity of construction, which permits precise detection of π^+ mesons over a wide energy range (15–180 Mev); absence of an analyzing magnet, which eliminates the multichannel path by changes in the absorber; relatively low (30%) efficiency, which prevents its use with low count rates; impossibility of using it with high backgrounds; and need to increase the nuclear interaction correction for high-energy π mesons, which necessitates thick absorbers. (IIC-M.G.)

34485 TRANSISTORIZED NEUTRON MONITOR. Leonov, V. Kh.; Mazaryuk, E. A. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR) (English Transl.), 4: 853-5(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1101-(1964).

The electronics of the neutron monitor are described. The circuits are transistorized. The input stage employs a highly efficient battery-powered tube. Some amplifier characteristics are described. A blocking oscillator serves as the shaping stage. The temperature dependences of the amplifier gain and of the operating threshold of the blocking oscillator are given. (auth)

34486 SEMICONDUCTOR DETECTORS AS COUNTERS FOR A MAGNETIC BETA SPECTROMETER. Walthard, B. Schellenberg, L.; Huber, O. (Universitaet, Freiburg i. B.). Helv. Phys. Acta, 38: 299-327(May 15, 1965). (In German)

Some general properties of commercially available Si-detectors are discussed. The problem of optimal preamplifiers in order to obtain best coincidence-resolution is then considered. With the assumption of exponential rise of the detector-pulse the optimal time-constants of the amplifier were found to be 2 to 10 times longer than that of the detector. Finally some coincidence-arrangements are described. (auth)

34487 ADVANCES IN RADIATION INSTRUMENTATION. Brunton, Donald C. Ind. Res., 7: No. 7, 76-80; 82(June 1965).

The growth of nuclear instrumentation in industry, research, and medicine in the last 15 years is reviewed. Activation analysis, tracer techniques, and radiometric gages are discussed. (C.E.S.)

34488 EFFECTS OF COLLIMATING DEVICE ON CALIBRATING AND CHECKING OF DOSIMETERS BY MEANS OF STANDARD γ SOURCES. Tuchin, V. N.; Ostromukhova, G. P.; Yudin, M. F. Izmeritel. Tekhn., No. 3, 58-61(Mar. 1965). (In Russian)

Since the dose delivered by a source of radiation at a given distance from it is determined by both the direct radiation and the radiation dispersed by the collimator, experiments were carried out to determine the effect of the source holder construction and of the diaphragm apparatus used for collimating the beam. The results of the work showed that the standard gamma sources used for calibrating a dosimeter may be placed in a collimator with a cylindrical opening. Studies with such a collimator showed that the contribution of the radiation dispersed by it to the measured dose intensity depends on the ratio between the diameter of the collimator opening and the length of the collimator. It was established experimentally that the effect of source holders of existing construction on the measured dose intensity is within the limits of precision of standard dosimeters (no greater than 0.3 to 0.5%). (TTT)

34489 SPARK CHAMBER SUITABLE FOR OBSERVATION OF MULTIPLE PARTICLES. Nagano, Motohiko; Shibata, Shinkichi (Tokyo Univ.). J. Phys. Soc Japan, 20: 685-93(May 1965).

Characteristics of the spark chamber (490 mm × 490 mm × 20 mm height) whose electrodes are covered with glass are presented. Constant efficiency in the range of 1 to 1,500 particles/m^2 is obtained experimentally, and the possibility of extension to 10,000 particles/m^2 is shown. The zenith angle is measured from the projected length of the track from 20 to 90° through electrode. As the efficiencies of the chambers are uniform, and do not decrease during long operation, the extension to large area is very easy and the chamber is useful for cosmic ray study. (auth)

34490 A FAST NEUTRON SPECTROMETER CAPABLE OF NANOSECOND TIME GATING. Beghian, L. E. (Massachusetts Inst. of Tech., Cambridge); Wilensky, S.; Burrus, W. R. Nucl. Inst. Methods, 35: 34-44(1965). (ORNL-P-1076)

A fast neutron spectrometer was constructed, which is capable of 200-kev energy resolution at 1 Mev and can be time gated to several nsec. The spectrometer is a proton-recoil scintillation detector. The neutron spectrum is obtained from the detector pulse height response by a modified least squares unfolding technique. The response of the detector to monoenergetic neutrons was measured and is used in conjunction with a computer code, SLOP, for unfolding the neutron spectrum. Results are presented to indicate the capabilities of the detector. Unfolded neutron spectra containing 1.0-Mev and 1.3-Mev lines are presented. The neutron spectra leaking out of a carbon assembly at two different time delays after the injection of a monoenergetic neutron pulse are also included. (auth)

34491 ACCURACY OF A LOGARITHMIC INTEGRATOR. Bachelart, G.; De Rosny, G. (Centre d'Etudes Nucleaires,

Saclay, France). Nucl. Instr. Methods, 35: 55-60(1965). (In French)

The accuracy of a logarithmic counting-rate meter, the principle of which is based on diode pump circuits, varies with the frequency of the pulses which are applied to it. A great number of parameters are to be taken into account for calculation of the error. It is shown that, for low count rates, statistical fluctuations account for most of this error. For high count rates, the main error is due to the tolerances of the nominal values of the resistances for the diode pump tank circuits. (auth)

34492 MEASUREMENT OF THE FINITE ANGULAR RESOLUTION CORRECTION FOR A NaI(Tl) CRYSTAL WHEN ONLY THE FULL-ENERGY PEAK IS INCLUDED. Reich, C. W.; Douglas, J. H. (Phillips Petroleum Co., Idaho Falls, Idaho). Nucl. Instr. Methods, 35: 67-71 (1965).

The correction factors for the finite angular resolution of the detector in gamma angular distribution and correlation experiments were measured for the case in which only those events which deposit their full energy in the detector are used in the analysis. The measurements are for the geometrical configuration of a right circular cylinder of NaI(Tl), 7.62 cm in diameter by 7.62 cm thick, with the source at a distance of 10 cm from the front face of the crystal. Gamma energies ranged from 0.077 to 1.84 Mev, with ten different sources being employed. The results are compared with those of two recent Monte Carlo calculations and with those computed under the assumption that all events arising from the interaction of the photon with the crystal are used in the analysis (that is, no pulse-height selection). (auth)

34493 AN AUTOMATIC SAMPLE CHANGER FOR LIQUID SAMPLES. Legal, J.; Mamacos, J. P.; Cartwright, E.; Holloway, A. F. (Manitoba Cancer Treatment and Research Foundation, Winnipeg, Can.). Nucl. Instr. Methods, 35: 72-6(1965).

A liquid sample changer capable of handling up to 98 samples at a time is described. This sample changer has been in operation for a considerable time with only minor adjustments and is currently handling about 3000 samples per month. (auth)

34494 COLLECTION TIME AND EQUIVALENT CIRCUIT OF SURFACE BARRIER SEMICONDUCTOR DETECTORS. Fabri, G.; Svelto, V. (Laboratori CISE, Milan). Nucl. Instr. Methods, 35: 83-7(1965).

The rise time of silicon surface-barrier detector pulses was measured under excitation by alpha particles. Such a measurement made it possible to check both the collection time of charge carriers in the depletion region and the equivalent circuit of the detector. The measurements were made by comparing, at the output of a fast amplifying chain, the waveforms due, respectively, to alpha particles and to artificial pulses obtained by injecting a calibrated charge ($\delta(t)$-current pulse) into the detector. The measured parameter T turns out to be equal to $T = \tau + R_s C_0 + R_c C_0$, where τ is the collection time, C_0 the depletion layer capacity, R_s the bulk resistance due to the undepleted material, and R_c a series resistance. It was experimentally verified that T, according to the theory, is a linera function of $V^{-\frac{1}{2}}$, where V is the detector bias. (auth)

34495 ON THE INFORMATION AVAILABLE FROM THE RISE-TIME OF THE CHARGE PULSE SUPPLIED BY SEMICONDUCTOR PARTICLE DETECTORS. Quaranta, A. Alberigi (Universita, Bologna); Casadei, G.; Martini, M.; Ottaviani, G.; Zanarini, G. Nucl. Instr. Methods, 35: 93-9(1965).

It is shown that by measuring the collection time of the charge released in the depletion layer of a solid-state radiation detector, some information can be obtained about the ionizing particle impact angle or about its range in the depletion layer. Several criteria are also given for selecting the detectors suitable to obtain the above mentioned information. (auth)

34496 ANALYSIS OF KINEMATICALLY CONSTRAINED BUBBLE CHAMBER EVENTS. Handler, R. (Univ. of Chicago). Nucl. Instr. Methods, 35: 100-4(1965).

A method is described for reducing measuring table output for a particular bubble chamber event to a set of vertex momenta obeying the appropriate constraint equations. The approach used is different from the one commonly employed. It combines the functions of the usual spatial reconstruction and kinematic fitting programs and is based on a procedure which weighs all input data points equally. (auth)

34497 POSSIBLE IMPROVEMENT OF SIGNAL-TO-NOISE RATIO BY CORRELATION IN AN EXPERIMENT ON PARTICLE IDENTIFICATION. Escudie, B.; Chery, R. (Institut de Physique Nucleaire, Lyon). Nucl. Instr. Methods, 35: 105-8(1965). (In French)

A technique for improving the signal-to-noise ratio in particle identification by energy losses in semiconductor detectors is analyzed. (D.C.W.)

34498 ON THE POSSIBILITY OF HIGH ENERGY PARTICLE DETECTORS BASED ON ULTRASONIC CAVITATION. Bertolotti, M.; Sette, D.; Wanderlingh, F. (Universita, Rome). Nucl. Instr. Methods, 35: 109-12(1965).

The possibility of detecting high-energy particles by cavitation processes in liquids is discussed, with particular consideration of devices that could use acetone, pentane, or water. The technique appears to be suitable for the detection of fast neutrons and the measurement of very low neutron fluxes. (D.C.W.)

34499 PREPARATION OF n-i-p DIODES FROM GERMANIUM. APPLICATION TO GAMMA SPECTROMETRY. Stab, L.; Henck, R.; Siffert, P.; Coche, A. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Instr. Methods, 35: 113-19(1965). (In French)

A method for the preparation of germanium n-i-p junctions is described, and results obtained in the use of such junctions in gamma spectrometry are discussed. (D.C.W.)

34500 AN EXTERNALLY QUENCHED HYDROGEN COUNTER FOR LOW LEVEL TRITIUM MEASUREMENTS. Takahashi, T.; Hamada, T.; Yamasaki, F. (Inst. of Physical and Chemical Research, Tokyo). Nucl. Instr. Methods, 35: 120-4(1965).

A counting system comprising a hydrogen-filled center counter surrounded by 2 cm of lead within a ring of gas-flow anticoincidence shield counters is described. Characteristics are included showing that the addition of a small amount of propane improves the performance of the center counter. The results of measurements of background counting rates and of determinations of tritium in rain water and underground water are also given. (D.C.W.)

34501 CALCULATION OF THE DETECTION EFFICIENCY OF A CYLINDRICAL COUNTER FOR X-RAYS FROM AN INTERNAL SOURCE. Byrne, J. (Univ. of Edinburgh). Nucl. Instr. Methods, 35: 125-9(1965).

The efficiency of a long cylindrical proportional counter for the detection of x rays from an isotropic point placed centrally in the wall of the counter is calculated. The results are applicable to counters of varied length and radius for a range of x-ray energies and are presented in both analytic and graphical forms. (auth)

34502 TOTALLY DEPLETED SURFACE SILICON DETECTORS: CONSTRUCTION AND PROPERTIES. Fabri, G.; Redaelli, G. (Laboratori CISE, Milan). Nucl. Instr. Methods, 35: 130-2(1965).

A method of preparing dE/dx surface barrier detectors was developed. Particular care was taken in the mounting assembly in order to allow operation at low temperatures. Furthermore, a number of investigations were carried out in connection with the formation of back contacts to reduce injection currents. (auth)

34503 ASYMMETRY IN SUM-COINCIDENCE SPECTRA. Brown, R. A.; Roulston, K. I. (Univ. of Manitoba, Can.). Nucl. Instr. Methods, 35: 133-7(1965).

A method of identifying peaks in spectra due to compton interactions is described, based on the asymmetry of spectra when two crystals of substantially different sizes are

used in the spectrometer. The theoretical bases of the method are outlined, and some experimental results are discussed. (D.C.W.)

34504 PARTICLE DISCRIMINATION SYSTEM FOR NUCLEAR REACTION STUDIES. Kootsey, J. Mailen (Brown Univ., Providence). Nucl. Instr. Methods, 35: 141-7(1965).

A solid-state system is described which applies the logarithmic method of computing the product $E \times dE/dx$ to the problem of mass discrimination of charged particles in counter telescopes. The basic conversion circuit uses the emitter-base junction of a transistor as the logarithmic element. The delay-line clipped amplifiers, zero-crossover coincidence circuits, and single-channel pulse-height analyzers used with the logarithmic convertors are also described. (auth)

34505 DETERMINATION OF THE MAXIMUM ENERGY OF NEUTRON SPECTRA BY MEANS OF THE REACTION IN LITHIUM AND A SINGLE SEMICONDUCTOR DETECTOR. Libert, J. (Centre de la Faculte Polytechnique, Mons, Belg.). Nucl. Instr. Methods, 35: 148-52(1965). (In French)

A technique for the determination of the maximum energy of a neutron spectrum is described in which a ^{6}LiF conversion layer and a single semiconductor detector are used. The uncertainty in the energy measurement is of the order of ±13 kev in the energy range considered (200 to 800 kev). (D.C.W.)

34506 BACKSCATTERING OF ELECTRONS IN AN ELECTROSTATIC ENERGY ANALYZER. Kessler, J.; Weichert, N. (Technische Hochschule, Karlsruhe, Ger.). Nucl. Instr. Methods, 35: 161-2(1965).

The results of an experimental investigation of electron backscattering in a spherical analyzer are discussed. The intensity at a counter across the analyzer from the electron source was measured as a function of analyzer voltage at different electron energies, and mean energy losses were determined. (D.C.W.)

34507 ANGULAR ERRORS IN SPARK CHAMBER TRACKS DUE TO SPARK PAIRING. Duff, B. G. (London Univ.); Heymann, F. F.; Walker, R. N. F.; Strong, J. A. Nucl. Instr. Methods, 35: 167-8(1965).

In the analysis of spark chamber photographs, it is often assumed that best fit lines through the centers of the sparks correspond to the paths of the ionizing particles. An expression for the errors in the track direction due to spark pairing is derived, and an application of such a correction to measurements on photographs in a π^--p elastic scattering experiment is summarized. (D.C.W.)

34508 ½ π √13 HIGH-PRECISION BETA-RAY SPECTROMETER. Daniel, H.; Jahn, P.; Kuntze, M.; Spannagel, G. (Max-Planck-Institut fur Kernphysik, Heidelberg). Nucl. Instr. Methods, 35: 171-2(1965).

An iron-free beta spectrometer with a curved exit slit at which there is no axial focus is discussed. The radial focusing angle is 324.5°, and the width of the exit slit can be varied continuously. The spectrometer was built for electrons with energies up to 4.5 Mev. (D.C.W.)

34509 A TRANSISTORIZED DEVICE CORRECTING FOR TIME-OF-FLIGHT ERRORS INTRODUCED BY TWO LAYER COUNTERS. Eder, J.; Roebbelen, D.; Strub, A. (EURATOM-CCR, Ispra, Italy). Nucl. Instr. Methods, 35: 173-5(1965).

A transistorized device which corrects for time-of-flight errors introduced by the use of neutron counters made of two or more layers of detectors is described. Circuitry is included by which an additional detector-pulse storage delay can be introduced to permit the measurement of flight-times longer than the chopper period. (D.C.W.)

34510 FOCUSING PROPERTIES OF AZIMUTH-DEPENDENT MAGNETIC FIELDS. Schmutzler, F.; Daniel, H.; Tauscher, L. (Max-Planck-Institut fur Kernphysik, Heidelberg). Nucl. Instr. Methods, 35: 176(1965).

An analysis of a double-focusing spectrometer with an azimuthally varying magnetic field is summarized. It was found that the aperture-aberration errors could be reduced to practically nothing. (D.C.W.)

34511 PULSE SUPERPOSITIONS IN GAMMA SPECTROMETRY. Quivy, R. (Centre de la Faculte Polytechnique, Mons, Belg.). Nucl. Instr. Methods, 35: 194-8 (Aug. 1965). (In French)

A general method is proposed for the calculation of the number of pulse superpositions and their height distribution in gamma spectroscopy from the experimental energy spectrum and the pulse shape. A method is also given for the correction of the superpositions occurring above the photoelectric peak, using two experimentally determined constants. (auth)

34512 TRACK SPARK CHAMBER WITH ISOTROPIC PROPERTIES AS A DEVICE TO STUDY HIGH-ENERGY NUCLEAR INTERACTIONS. Chikovani, G. E.; Roinishvili, V. N.; Mikhailov, V. A.; Yavrishvili, A. K. (Inst. of Physics, Tbilissi, USSR). Nucl. Instr. Methods, 35: 197-202(Aug. 1965).

The results of a study of the regime of operation of a track spark chamber with isotropic properties are given in which the kind of gas used and the strength of the electric field were considered. At a field strength of ≈14 kv/cm, the dimensions of streamers along the electric field and perpendicular to it are about the same; as a result the track spark chamber becomes a truly isotropic device. (auth)

34513 LARGE AREA ^{6}LiI(Eu) DETECTOR BANK FOR SLOW NEUTRON TIME-OF-FLIGHT MEASUREMENTS. Strub, A. (Euratom CCR, Ispra, Italy). Nucl. Instr. Methods, 35: 203-9(Aug. 1965).

For slow-neutron time-of-flight experiments, a large-surface detector bank was constructed which uses 20 ^{6}LiI(Eu) crystals, 2 mm thick and 3-in. in diameter, mounted on 20 phototubes. After a general consideration of the properties of LiI(Eu) scintillators, the construction of the bank is described. Some typical performances are presented. The neutron counting efficiency of the bank is better than that of the normally used BF_3 counters and follows a simple $1/v$ law. Thus, corrections for efficiency become low and easily calculable. Unfortunately, this is at the price of a non-negligible gamma sensitivity. For short flight-times, the improvement in time resolution by a factor of about 50 compared with equivalent BF_3 counters may be interesting. (auth)

34514 ON THE OBTENTION OF UNIFORM MAGNETIC FIELDS UTILIZED IN HIGH-RESOLUTION BETA-SPECTROGRAPHY. Paris, P.; Seige, G. (Centre de Spectrometrie Nucleaire, Orsay, France). Nucl. Instr. Methods, 35: 242-4(Aug. 1965). (In French)

A method is described for obtaining suitably homogeneous magnetic fields in semi-circular beta spectrographs, using permanent magnets. (D.C.W.)

34515 A METHOD FOR PULSE SHAPE DISCRIMINATION. Fuelle, R.; Mathe, Gy.; Netzband, D. (Zentralinstitut fur Kernforschung, Rossendorf, Ger.). Nucl. Instr. Methods, 35: 250-60(Aug. 1965).

The principles of particle identification on the basis of the differences in the rise times of multiplier pulses caused by different kinds of particles are presented, and an apparatus for pulse shape discrimination is described in which a time-to-pulse height converter is used to measure the differences of the crossing time. The results of measurements with Cs I(Tl) and Na I(Tl) crystals are discussed. Calculations are included by which the results can be explained. (D.C.W.)

34516 THE ORGANIC SCINTILLATOR AS A 10-30 Mev NEUTRON SPECTROMETER. Lewis, C. W.; Blair, J. M. (Univ. of Minnesota, Minneapolis). Nucl. Instr. Methods, 35: 261-70(Aug. 1965).

An expression which accurately represents the high-energy portion of the pulse-height distribution produced by an organic scintillator used as a detector of approximately monoenergetic neutrons is derived. The expression

is applicable to neutrons in the 10 to 30 Mev range and is readily used in connection with a high-speed computer for complex experimental spectra analysis. Such an application is illustrated by determining angular distributions of several high Q value (20 Mev) neutron reactions produced in the lithium bombardment of some light nuclei. The results demonstrate the feasibility of measuring neutron differential cross sections in the 10 to 100 microbarn region by this method. (auth)

34517 SURFACE-ESCAPE CORRECTIONS IN "SELF-SCINTILLATION" MEASUREMENTS OF BETA SPECTRA. Spaeth, M. L.; Beard, G. B. (Wayne State Univ., Detroit). Nucl. Instr. Methods, 35: 271-6(Aug. 1965).

The spectra of the radiations escaping from several materials containing beta emitters were studied, the most important case being that of ^{40}K contained in KI. The results indicate that the escaping radiation consists of electrons, bremsstrahlung, and x rays. It is shown how a reasonably good correction can be made for the escaping electrons in the measurement of a beta spectrum using the "self-scintillation" method. For high-Z materials, it is also shown that a further correction is needed for the escaping electromagnetic radiation. Such a correction would be difficult to make so that, in general, it may be better to use low-Z scintillating materials containing the radioisotope of interest, particularly for those cases having a high beta end-point energy. (auth)

34518 RANGE-ENERGY MEASUREMENTS IN ORWO-K2-EMULSIONS. Eckardt, A.; Bachtik, K. H.; Goetz, G. (Friedrich Schiller Universitaet, Jena, Ger.). Nucl. Instr. Methods, 35: 290-2(Aug. 1965).

Making use of the most energetic proton groups from the reaction $^{10}B(d,p)^{11}B$ four calibration points of the range-energy curve were determined in the energy interval from 4 to 9 Mev for protons in ORWO-K2-emulsions. The values lie within their permissible error on the calculated curve, which can now be regarded as experimentally verified in the region from 0.5 to 14 Mev. (auth)

34519 A LIQUID CHERENKOV COUNTER SYSTEM FOR K^+ DETECTION IN THE RANGE OF 0.60 TO 2.0 Gev/c. Ozaki, S. (Brookhaven National Lab., Upton, N. Y.); Russell, J. J.; Sacharidis, Reed, J. T. Nucl. Instr. Methods, 35: 301-8(Aug. 1965). (BNL-9037)

The design and performance of a high-efficiency, high-resolution liquid Cherenkov counter system, used for the detection of meson (K^+) in the range of 0.60 to 2.0 Bev/c, are described. Meson (K^+) efficiencies above 80% with pion and proton rejection ratios better than 10^5 have been obtained. (auth)

34520 RANGE-MOMENTUM CURVES FOR HEAVY LOW VELOCITY IONS IN NUCLEAR EMULSIONS. Lou, A. (Univ. of California, Los Angeles). Nucl. Instr. Methods, 35: 321-2(Aug. 1965).

The available data on the ranges of heavy ions in nuclear emulsions at low velocities were reanalyzed. A set of range-momentum curves for ^{108}Ag, ^{80}Br, ^{12}C, ^{14}N, and ^{16}O were calculated. Calculated values of range vs momentum for ions with z = 15, 20, 25, 30, 35, 40, and 47 are included. (D.C.W.)

34521 A NEW READOUT AND MEMORY METHOD FOR A MULTIWIRE SPARK CHAMBER. Miyamoto, S. (Osaka City Univ.). Nucl. Instr. Methods, 35: 323-4 (Aug. 1965).

A memory and readout system for the positions of sparks is described in which the currents in the chamber wires are converted into sound which is sent along a delay line. (D.C.W.)

34522 MEASUREMENT OF TUBE PARAMETERS AND THEIR INFLUENCE ON RESOLUTION ON PREAMPLIFIERS USED WITH SEMICONDUCTOR PARTICLE DETECTORS. Leventhal, E. A. (Philips Labs., New York). Nucl. Instr. Methods, 35: 325-7(Aug. 1965).

A condition that relates an optimum preamplifier capacitance to the detector capacitance is derived; the intercept and initial slope of the resolution vs external capacitance curve are expressed in terms of the parameters of the preamplifier input tube. A method for determining tube parameters is also described. (D.C.W.)

34523 CANCELLATION OF PHOTOMULTIPLIER GAIN DRIFT FOLLOWING SOURCE INTENSITY CHANGE. Brimhall, J. E.; Page, L. A. (Univ. of Pittsburgh). Nucl. Instr. Methods, 35: 328-30(Aug. 1965).

A method for cancelling gain drifts in photomultiplier tubes is described in which a single adjustment of the high voltage is used to counteract a given, sudden source intensity change. The results of measurements of the drift characteristics of several photomultipliers with which Na I(Tl) crystals and various radiation sources were used are discussed. (D.C.W.)

34524 A Ge(Li) GAMMA RAY SPECTROMETER. Fox, R. J.; Williams, I. R.; Toth, K. S. (Oak Ridge National Lab., Tenn.). Nucl. Instr. Methods, 35: 331-3 (Aug. 1965). (ORNL-P-1314)

A gamma- and x-ray spectrometer is described in which a lithium-drifted germanium crystal immersed in liquid nitrogen is used. Photopeak detection efficiency curves obtained for Ge(Li) and Na I(Tl) crystals using x and gamma sources are included, together with ^{207}Bi gamma calibration spectra obtained with both types of crystals. Photon spectra obtained from gadolinium isotopes using Ge(Li) detectors demonstrate the use of the detector both in the conventional manner and as a sum spectrometer. (D.C.W.)

34525 THE POLAR SCANNER. Robinson, C. J.; Duff, M. J. B. (London Univ.). Nucl. Instr. Methods, 35: 334-6(Aug. 1965).

A device for scanning photographic film is briefly described, and the operation of the scanner is outlined. (D.C.W.)

34526 BI-PARAMETRIC ANALYSIS OF AMPLITUDE-AMPLITUDE CORRELATION AND IDENTIFICATION OF γ-CASCADE DECAY. Sarquiz, Ph. (Intertechnique, Plaisir, France). Nucl. Instr. Methods, 35: 337-8 (Aug. 1965). (In French)

A system for suppressing accidental coincidences in bi-parametric correlation measurements is described, which is based on the application in bi-parametric analysis of the method of Hoogenboom. (D.C.W.)

34527 A BETA PROPORTIONAL COUNTER WITH A PLASTIC ANTI-COINCIDENCE SHIELDING AS A LOW BACKGROUND ASSEMBLY. Ramaniah, M. V.; Rao, C.; Sakuel, J. K. (Atomic Energy Establishment, Trombay, India). Nucl. Instr. Methods, 35: 339-40(Aug. 1965).

A counter assembly comprising a gas-flow beta proportional counter set into the well of a cylindrical plastic scintillator is described. The assembly has a background count rate of 1.4 cpm. (D.C.W.)

34528 A SCALAR PRINTOUT SYSTEM. Barna, A.; Horelick, D. (Stanford Univ., Calif.). Nucl. Instr. Methods, 35: 341-5(Aug. 1965).

A printout system is described with which the data from up to fourteen 7-decade scalers can be printed onto 3-in.-wide paper tape in less than 3 sec. (D.C.W.)

34529 A LARGE CO_2 FILLED PROPORTIONAL COUNTER WITH REDUCED SENSITIVITY TO ELECTRON ATTACHMENT. Cleyet, B. (Univ. of California, Santa Barbara). Nucl. Instr. Methods, 35: 346(Aug. 1965).

A CO_2-filled proportional counter is described in which difficulties with electron attachment are reduced by using seven small counters arranged in a stainless steel tube. Tests showed that a single counter of the same volume was approximately seven times more sensitive than the multiple counter. (D.C.W.)

34530 A dE/dx-E-T PARTICLE IDENTIFICATION SYSTEM. Parkinson, E. R.; Bodansky, D. (Univ. of Washington, Seattle). Nucl. Instr. Methods, 35: 347-9 (Aug. 1965).

A particle identification system is described in which

the energy-loss and time-of-flight methods are combined. (D.C.W.)

34531 A TRIGGER TUBE REVERSIBLE BINARY SCALER. Oxley, A. J. (Oxford Univ.). Nucl. Instr. Methods, 35: 350-2(Aug. 1965).

A reversible binary scaler is described in which cold-cathode gas-filled trigger tubes are used. (D.C.W.)

34532 CONSTRUCTION AND CHARACTERISTICS OF A SIMPLE IRON-FREE β SPECTROMETER FOR SINGLE AND COINCIDENCE MEASUREMENTS. Fritsch, F.; Fischer, K.; Muennich, F.; Schaare, W. (Technische Hochschule, Brunswick). Nukleonik, 7: 172-9(Apr. 1965). (In German)

The structure of an iron-free double-lens β-spectrometer is described, which can be used in the following measuring arrangements: as a double-lens spectrometer with an energy resolution capability of 0.8% with 1.2% transmission; as a double-lens spectrometer with a gamma detector for β-γ coincidence measurements; and as a β-β coincidence spectrometer, where each coil of the double-lens spectrometer operates as a separate spectrometer. In order to allow for the mutual interference of the two coils, a correction formula was calculated, whose validity was experimentally proved. The test measurements in the case of ^{137}Cs and ^{144}Ce confirmed the various applications of the instruments. (tr-auth)

34533 AN IRON-FREE BETA SPECTROMETER WITH TOROIDAL MAGNETIC FIELD. Moll, Eberhard; Kankeleit, Egbert (Technische Hochschule, Munich). Nukleonik, 7: 180-3(Apr. 1965). (In German)

A simplified and electron-optically modified iron-free version of the orange spectrometer was constructed. For a source of 2 mm in diameter, the resolution is 0.35% with a detection efficiency of 15%. (tr-auth)

34534 ON THE PENETRATING COMPONENT OF EXTENSIVE AIR SHOWERS. Bingham, R. G.; Kellermann, E. W. (Univ. of Leeds, Eng.). Nuovo Cimento (10), 38: 1-6(July 1, 1965).

The performance of a penetrating particle detector, originally designed to examine sidereal time variations, was examined in conjunction with a small air shower array. It is found that the detector is sensitive to muons of energy >700 Mev and to nuclear-active particles of energy >15 Bev. Results of the Sydney group regarding the lateral structure function of nuclear-active particles are confirmed and shown to be valid up to 1 m core distance. Evidence is found in air showers of muon beams of energy >6 Bev. (auth)

34535 INVESTIGATIONS ABOUT IONIZATION CHAMBERS FILLED BY A DIELECTRIC LIQUID. Blanc, D.; Mathieu, J.; Torres, L.; Vermande, P. (Faculte des Sciences, Toulouse). Onde Elec., 45: 466-71(Apr. 1965). (In French)

Investigations were made on the comparison between the plateau curves obtained for alpha, gamma rays, and fast neutrons: for every type of radiation, extrapolations of plateau curves for different values of the fluxes intersect in a point on the abscissa axis. The typical points for incident radiations are distributed on the abscissa axis in an order which appears to be the order of RBE. These results give a great interest to such detectors in biologic dosimetry. (auth)

34536 MICROELECTRONICS TECHNIQUES AND NUCLEAR INSTRUMENTATION. Sarquiz, M. (CEN, Saclay, France). Onde Elec., 45: 472-5(Apr. 1965). (In French)

General questions dealing with the use, in connection with future nuclear instrumentation, of new components appearing now on the market because of the industrialization of microelectronic's techniques are examined. (auth)

34537 PRESENT-DAY AND FUTURE TECHNIQUES IN RAPID NUCLEAR ELECTRONICS. Mey, J. (CEN, Grenoble, France). Onde Elec., 45: 476-84(Apr. 1965). (In French)

An assessment is made of the most significant results obtained during the last two years in the field of rapid nuclear electronics. Then an attempt is made to clear up ideas which are still speculative on the developments which it seems reasonable to expect in the immediate future. (auth)

34538 THE USE OF FAST TRANSITIONS IN QUANTUM COUNTER APPLICATIONS. Chamberlain, J. R. (Mullard Research Labs., Redhill, Surrey, Eng.). Phys. Letters, 16: 261-2(June 1, 1965).

Pointed out are the necessities and difficulties in quantum counter action in a three level system. The method suggested for overcoming these difficulties is to use five levels with fast transitions employed to connect levels being used. (M.O.W.)

34539 NEUTRON He^3 SPECTROMETER FILLED TO 40 ATM. Glazkov, N. P. Pribory i Tekhn. Eksperim., No. 3, 53-6(May-June 1965). (In Russian)

The characteristics of a spherical ^3He chamber of diameter 40 mm filled to 40 atm are presented. The time for electron collection at a voltage of 6 kv is equal to 5 μsec. The energy resolution in the range 0.1 to 1.2 Mev is 100 to 150 kev for average efficiency of 0.25%. (tr-auth)

34540 EFFECTIVE NEUTRON SPECTROMETER INSENSITIVE TO GAMMA RAYS. Prokopets, G. A.; Strizhak, V. I. (Kiev State Univ.). Pribory i Tekhn. Eksperim., No. 3, 56-60(May-June 1965). (In Russian)

An effective scintillation spectrometer for fast neutrons, practically insensitive to gamma rays, for the neutron energy range from 0.6 to 10 Mev was constructed. The operation of the spectrometer was verified for the neutrons of the $D(d,n)^3He$ and $T(d,n)^4He$ reactions at a deuteron energy of 100 kev and also using Po–Be neutron sources. The apparatus is used for measuring differential cross sections of neutron scattering. The possibility of such an application is demonstrated by spectra of neutrons scattered by nickel and iron. (tr-auth)

34541 DEVICE FOR MEASURING γ-RAY RESONANCE ABSORPTION. Mitrofanov, K. P. (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 3, 60-4(May-June 1965). (In Russian)

A semi-automatic device is described for measuring γ-ray resonance absorption spectra. A constant-current motor is used for the moving part; its rotation rate is given by the change of parameters of a potentiometer connected with an electronic stabilization circuit. The rotational motion is transformed into translational motion by a cylindrical cam. The range of variation of the rate is from 0.02 to 30 mm/sec. A four-section resonance counter is used for recording the γ rays. (tr-auth)

34542 STABILIZATION OF A SCINTILLATION SPECTROMETER. Batalin, S. S.; Dombrovskaya, G. S.; Kaipov, D. K. (Inst. of Nuclear Physics, Kazkh SSR). Pribory i Tekhn. Eksperim., No. 3, 64-6(May-June 1965). (In Russian)

A system for stabilization of photomultiplier gain is described. The gain is automatically regulated using a reverse connection which includes the whole spectrometer channel (photomultiplier-high-voltage rectifier-amplifier) and corrects the operation regardless of which of the links is unstable. Control of the photomultiplier gain is carried out by regulating the high voltage in response to the change in a control signal. The main stabilization circuit is presented. Results of tests are given, showing the change in output signal as a function of time, with and without stabilization, and the photopeak amplitude as a function of supply voltage. (M.J.T.)

34543 USE OF PROPORTIONAL AND SCINTILLATION COUNTER TELESCOPES FOR INVESTIGATIONS OF LOW-ENERGY PHOTONUCLEAR REACTIONS. Volkov, Yu. M.; Denisov, V. P.; Kulchitskii, L. A. (Inst. of Physics and Tech., Leningrad). Pribory i Tekhn. Eksperim., No. 3, 67-71(May-June 1965). (In Russian)

A method is described for measuring energy spectra and identifying by mass the protons, deuterons, and tritons produced in photonuclear reactions in the low-energy

range of the investigated particles (2 to 20 Mev). A telescope, consisting of front proportional and back scintillation counters (the dE/dx-E method), is used for this purpose. The use of a proportional counter with low sensitivity to background and with small volume and the formation of short pulses from the scintillation counter with subsequent discrimination of low background pulses allow difficulties associated with the superposition of background pulses to be avoided and large solid angles to be employed. (tr-auth)

34544 ISOTROPIC DISCHARGE COUNTER FOR RECORDING TRACKS OF RELATIVISTIC CHARGED PARTICLES. Butslov, M. M.; Komarov, V. I.; Savchenko, O. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 3, 75-81(May-June 1965). (In Russian)

A discharge chamber is described, in which tracks of relativistic charged particles can be recorded independently of the direction of the trajectory relative to the applied field. The operating characteristics of the chamber are presented. (tr-auth)

34545 SPARK COUNTERS WITH ISOLATED ELECTRODES. Novikov, L. S. Pribory i Tekhn. Eksperim., No. 3, 81-3(May-June 1965). (In Russian)

The operation of spark chambers with electrodes covered with plexiglass plates is described. In addition, supplementary partitions of plexiglass or polyethelene, forming clearances of 2, 4, 7, 10, 15, 60 mm, are placed in the chambers. The chambers operated with various gas fillings (Ne, Ar, Ne-Ar mixture, and mixture of Ne with alcohol vapors) at various gas pressures. (tr-auth)

34546 LUMINESCENCE COUNTER WITH PLASTIC FILAMENT SCINTILLATOR. Butslov, M. M.; Komarov, V. I.; Savchenko, O. V.; Soroko, L. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 3, 84-7(May-June 1965). (In Russian)

A variation of a luminescent chamber is described, having a working volume of scintillator, composed of filaments, of 3500 cm^3. Photographs of cosmic-particle tracks obtained using this chamber are presented, and some questions on the use of luminescent chambers in high-energy particle physics are considered. (tr-auth)

34547 UNIFORM DISTORTIONS IN NUCLEAR EMULSIONS AND THEIR INFLUENCE ON THE MEASURED PATH LENGTH. Berkovich, I. B.; Skirda, N. V. Pribory i Tekhn. Eksperim., No. 3, 88-90(May-June 1965). (In Russian)

The effect shown by uniform distortions of an emulsion on the path length of a particle in the layer is estimated quantitatively. It is shown that the maximum increment of the path length ΔR_{max} in layers of 400 μ thickness can reach 5 to 8% depending on the level of deformation. So significant an effect can not avoid being taken into consideration in exact measurements of particle energies or in construction of exact empirical dependences of R(E). Apparatus for elimination of the demonstrated effect is described. (tr-auth)

34548 SILICON SURFACE-BARRIER DETECTORS SEALED IN EPOXY RESIN. Mednikov, A. K. (Inst. of Nuclear Physics, Kazkh SSR). Pribory i Tekhn. Eksperim. No. 3, 91-3(May-June 1965). (In Russian)

A technique for preparation of Si surface-barrier detectors of nuclear radiation, improving several characteristics of these devices, is described. (tr-auth)

34549 STATISTICAL LIMITATIONS IN RESOLVING TIME AND EFFICIENCY OF SCINTILLATION COUNTERS. Yakushin, V. V. (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 3, 93-9(May-June 1965). (In Russian)

A calculation of the minimum resolution time and the maximum efficiency of a scintillation counter for any (including as small as desired) energy of the recorded particles is carried out on the basis of the correct approximation to statistical processes. Recommendations are given for the selection of scintillating materials for recording nuclear particles of low energy. (tr-auth)

34550 THE POSSIBILITIES OF CHERENKOV COUNTERS WITH TOTAL INTERNAL REFLECTION. Zrelov, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 3, 100-3(May-June 1965). (In Russian)

Two possibilities for the creation of Cherenkov counters with total internal reflection and high velocity resolution for narrowly collimated particle beams are considered. Both variations are based on the large directional sensitivity of emission of Cherenkov radiation from the radiator to the angle of Cherenkov emission within the radiator, near the angle of total internal reflection. In one variation, the angle of refraction of the Cherenkov radiation at the radiator edge perpendicular to the direction of motion of the particle is measured, and in the other, the angle at the radiator edges parallel to the direction of particle velocity. (tr-auth)

34551 OPTICAL AND COUNTING CHARACTERISTICS OF SLOW NEUTRON DISPERSION DETECTOR. Timofeeva, T. V.; Tsirlin, Yu. A. Pribory i Tekhn. Eksperim., No. 3, 104-6(May-June 1965). (In Russian)

Slow-neutron dispersion detectors consisting of a layer of grains of the phosphor T-1 are considered. The attenuation of light flux in the detector, the dependence of the attenuation coefficient on the phosphor grain size, and the efficiency of the detector for slow neutrons are calculated on the basis of the theory of the diffusion of light. Comparison of the calculation with experiment shows their satisfactory agreement and the applicability of the calculation for the determination of the optimum characteristics of a detector of the given type. (tr-auth)

34552 PRE-AMPLIFIER AND MULTIPLIER FOR SPECTROMETERS WITH SEMICONDUCTOR DETECTOR. Kozlov, V. A. (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 3, 107-11(May-June 1965). (In Russian)

A survey and analysis of factors affecting the energy resolution of a spectrometer of nuclear particles using a semiconductor detector is given. The coefficient of amplification is calculated for the case of a charge-sensitive preamplifier. The circuits of the preamplifier and the linear amplifier with multiplier are given. Main attention is paid to the increase of stability of the amplification coefficient of the spectrometer as a whole. The effect of the thickness of the active layer of the α source and of the dead layer in diffusion drifted detectors on the broadening of spectral lines is noted. The energy resolution attained is about 20 kev. (tr-auth)

34553 PULSE SHAPE AND GATE CIRCUIT FOR PHOTOELECTRIC MULTIPLIER WITH TUNNEL DIODE. Shevchenko, N. G.; Reva, D. P. (Inst. of Physics and Tech., Kharkov). Pribory i Tekhn. Eksperim., No. 3, 112-14(May-June 1965). (In Russian)

The principal circuit of the voltage pulse shaper of a photomultiplier with a Ge tunnel diode is described. The pulse shaper gives at the output a signal of amplitude 0.4 to 0.45 v right up to ten times the threshold of wear. The time resolution of the pulse shaper is not worse than 30 nsec. A circuit was set up with the same tunnel diode, which allows pulses of the photomultiplier to pass into the scaler only at the time of the synchronization pulse and does not worsen the resolving time of the shaper. (tr-auth)

34554 PULSE SPECTROMETER OF NUCLEAR MAGNETIC RESONANCE. Shevelev, V. A. Pribory i Tekhn. Eksperim., No. 3, 135-9(May-June 1965). (In Russian)

A NMR pulse spectrometer whose distinguishing feature is the coherence of h-f pulses is described. Standard apparatus is partially used in the construction of the device. A simple device for formation of a series of trigger pulses for the determination of the spin-spin relaxation time according to the Carr-Purcell method is presented. (tr-auth)

34555 ELECTRON "JALOUSIE" TYPE MULTIPLIER FOR RECORDING CHARGED PARTICLES. Ainbund, M. R.; Vildegrube, G. S.; Dunaevskaya, N. V. Pribory i Tekhn. Eksperim., No. 3, 228-30(May-June 1965). (In Russian)

The constructions of Jalousie secondary-electron multipliers with open input are described. Some parameters and recommendations for applications are given. (tr-auth)

34556 MAGNETIC FIELD METER WITH A ZERO READING FOR MI-1305 MASS SPECTROMETER. Panyan, M. G.; Teplykh, A. F. (Leningrad Technological Inst.). Pribory i Tekhn. Eksperim., No. 3, 238-9(May-June 1965). (In Russian)

A magnetic field meter with zero reading for a mass spectrometer with serial output is described. The measurement accuracy and stability in time are not worse than 0.01%; this provides the possibility of preliminary and fast (from 15 to 20 sec) determination of the maxima of discrete lines of isotopes in the collector of the mass spectrometer. (tr-auth)

34557 THE VARIATION OF RESOLUTION WITH GAMMA ENERGY IN ACTIVATED ALKALI HALIDE CRYSTALS. Hill, R.; Collinson, A. J. L. (Borough Polytechnic, London). Proc. Phys. Soc. (London), 85: 1067-73(June 1965).

The intrinsic resolution of ten activated alkali halide crystals was measured over an energy range of 30 kev to 1 Mev. After subtracting the contributions to resolution due to non-proportionality of electron response and to delta rays, a residual resolution is left which consists of an energy dependent term and an energy independent term. The existence of the energy dependent term is not in agreement with the work of Prescott and Takhar, and shows that the variance of the photons produced in the scintillation process is greater than normal. The energy dependent term is sensitive to strain and to the surface condition of the crystal. (auth)

34558 RADIATION INTENSITY MEASUREMENTS WITH SILVER-ACTIVATED GLASS BLOCK DOSIMETERS. Ritz, Victor H.; Cheek, Conrad H. (Naval Research Lab., Washington, D. C.). Radiation Res., 25: 537-51(July 1965).

A method for measuring both the intensity (ev/cm^2-sec) of a radiation beam and the fraction of the incident intensity that is absorbed by a sample is described. The beam is totally absorbed in a block of silver-activated metaphosphate glass (1 cm × 1 cm × 0.3 cm thick), and the resultant change in optical density is used as a measure of the beam intensity. The fraction of the incident intensity absorbed by a sample is determined by comparing the optical densities of blocks exposed to the incident flux with and without the specimen interposed. Since the method requires the total absorption of the beam in the glass blocks, its use with blocks 0.3 cm thick is limited to low-energy x rays and particles, such as electrons, which can be totally absorbed in about 1 g/cm^2 of the glass. The use of the blocks with x rays from a beryllium-window tube operated at exciting potentials from 10 to 50 kv is described as well as their use with 1- to 2-Mev electrons from a Van de Graaff accelerator. The energy absorbed in various alkali halides under x irradiation as measured by the glass blocks was compared with that calculated from the x-ray tube spectra and appropriate energy absorption coefficients. Similar comparisons were made for electron irradiations intermediate between the thin target case and total absorption of the electron beam. This method provides a way of measuring the intensity of a radiation beam and the fraction of this intensity that is absorbed by samples that fall between the thin target case and that of total absorption. The small size of the blocks permits their use without the extensive alteration of the geometry of the experiment which might be required for the use of a calorimeter or chemical dosimeter. (auth)

34559 NEUTRON CRYSTAL SPECTROMETER WITH RANGE EXTENDED TO SUBTHERMAL ENERGIES. Rustad, B. M. (Columbia Univ., New York); Melkonian, E.; Havens, W. W. Jr.; Taylor, T. I.; Gould, F. T.; Moore, J. A. Rev. Sci. Instr., 36: 887-900(July 1965). (BNL-8366).

A neutron crystal spectrometer is described which has the following features: a useful range from 0.1 to 11.5 Å, exceptional reproducibility for high precision experiments, complete automatic control for measuring sample transmission as a function of wavelength, a temperature regulated sample changer with range from 196 to 300°C, and direct recording of data on punch cards, and a FORTRAN program for the statistical analysis of the data on a digital computer. Three alternate techniques were investigated and developed for extending the range of the spectrometer to wavelengths longer than 1 Å where the relative intensity of higher order Bragg reflections becomes large. In two of the methods, crystalline filters are used to attenuate shorter wavelength neutrons in the beam. In the third, a mechanical neutron velocity selector is used which transmits only the desired first order reflection. The residual higher order contamination in the spectrometer beam was measured to be less than 0.5% over the useful range of each technique. Examples of cross section measurements on V, Gd, and crystalline and fused quartz are presented. The total cross section of vanadium, which is used as a reference standard in many neutron scattering experiments, was determined to be $\sigma_T = (4.93 \pm 0.02) + (2.78 \pm 0.01)\lambda(\text{Å})$ barns in the region from 0.1 to 4.0 ev (0.92 to 0.145 Å). The total cross section of normal gadolinium measured at thermal energy (0.0253 ev) is 50,400 ± 500 b. (auth)

34560 ULTRAHIGH FREQUENCY NUCLEAR MAGNETIC RESONANCE SPECTROMETER. Jefferts, K. B.; Jones, E. D. (Bell Telephone Labs., Murray Hill, N. J.). Rev. Sci. Instr., 36: 983-4(July 1965).

A spectrometer designed for operation between 600 and 700 Mc with samples at very low temperatures is described. The basic design is applicable between about 200 and 1000 Mc. (auth)

34561 LARGE COLLECTING AREA SEALED PROPORTIONAL COUNTER. Bowyer, C. Stuart (Naval Research Lab., Washington, D. C.). Rev. Sci. Instr., 36: 1009-12(July 1965).

A large collecting area proportional counter for soft x-ray spectroscopy is described. The counter is a sealed instrument designed for inclusion in a rocket borne instrumentation package. The counter has an 82 cm^2 collecting area and is sensitive from 1 to 8 Å. The energy spread of the counter with an ^{55}Fe source is 34%. (auth)

34562 SIMPLE AUTOMATIC SCANNER FOR SPARK CHAMBER PHOTOGRAPHS. Rust, D. R.; Sinclair, C. K.; Talman, R. M. (Cornell Univ., Ithaca, N. Y.). Rev. Sci. Instr., 36: 1012-17(July 1965).

An automatic scanner useful for analyzing the photographs of some spark chamber systems is described. The images of all spark chamber gaps must be aligned with the edge of the film. The film is transported at constant speed and spark positions are recorded as the times the sparks pass fixed sensors; one per gap. Digitization along the gaps is accomplished by interpolating with clock pulses between marks on a uniform scale photographed on each frame. Output is on punched cards but conversion to magnetic tape is planned. (auth)

34563 LOW SCATTER, LIGHTWEIGHT FISSION SPECTROMETER. Frigerio, N. A. (Argonne National Lab., Ill.). Rev. Sci. Instr., 36: 1048-9(July 1965).

A low-scatter lightweight fission spectrometer for determining neutron fluxes from thermal to Mev energies is described. The unit was constructed primarily of tinned steel and operated using P-10 gas at a flow rate of 50 cm^3 sec^{-1} and a collection plate voltage of +1100v. These two π fission counters are found to be simple, reliable, and precise, and also were more suitable for some studies. (J.F.P.)

34564 ANGULAR CALIBRATION OF A CHARGED PARTICLE DETECTION CHAMBER. Poore, R. V.; Williamson, R. M. (Duke Univ., Durham, N. C. and Univ. of North Carolina, Chapel Hill). Rev. Sci. Instr., 36: 1051-2(July 1965).

It was found that the H(d,d)H reaction can provide a rapid and accurate method for calibration of the scattering angle with respect to the incoming beam. The width of the deuteron peaks is usually much greater than the resolution of a solid state detector. In general there will be two monoenergetic groups of the observed particle whenever the incident particle is heavier than the residual nucleus. (J.F.P.)

34565 DEVELOPMENT OF MULTICOUNT SYSTEM WITH A LARGE SCINTILLATION HODOSCOPE. Chang, Nai-seng; Hsu, Yun-chang; Ho, Yuang-fu; Mel'nikov, G. V.; Vovenko, A. S. Wu Li Hsueh Pao, 21: 748-64 (Apr. 1965). (In Chinese)

A multicount system, in which are included a large scintillation hodoscope and an electronic multichannel circuit, was developed and installed for the study of elastic and inelastic π^+- and K^+-meson interactions with protons at high energies. The scintillation hodoscope with the overlapping system of ring and sector scintillators has a diameter of 1 m. It is intended for the recording of particles from a liquid H target. The efficiency of the hodoscope for recording relativistic charged particles is about 100%. The 20-channel electronic scheme, operating together with the hodoscope, was tested. The fast coincidence scheme in it has a time resolution of 5×10^{-9} sec and an efficiency of 100%. The slow coincidence scheme has an efficiency of about 100% for a time resolution of (25 to 30) $\times 10^{-9}$ sec. (tr-auth)

34566 PRIBORY I METODY ANALIZA IZLUCHENII. VYPUSK III. (Apparatuses and Methods of Radiation Analysis. Issue 3). Stolyarova, E. L. Moscow, Gosatomizdat, 1962. 191p.

Nineteen papers are included. Separate abstracts were prepared for 18. One paper was previously abstracted for NSA; see abstract 19: 30569. (M.J.T.)

For abstracts of individual papers see: 34567, 34568, 34569, 34570, 34571, 34572, 34573, 34574, 34575, 34576, 34577, 34578, 34800, 34828, 35575, 35576, 35577, and 35578.

34567 STUDY OF THE RESPONSE OF A SINGLE-CRYSTAL SCINTILLATION gamma SPECTROMETER WITH A 80 × 80 mm NaI(Tl) CRYSTAL. Larichev, A. V.; Cherevatenko, G. A. pp 47-52 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

A description is given of an experimental study of the energy resolution, the light contribution, and the contribution of Compton scattering to the instrumental spectrum as a function of the gamma energy for a single-crystal scintillation spectrometer with a large NaI(Tl) crystal. The energy resolution depends linearly on the argument $E^{-\frac{1}{2}}$, where E is the energy of the investigated gamma rays. The values obtained for the light contribution to the instrumental lines for energies in the range 0.279 to 1.12 Mev agree well with results of calculations. The number matrix for the Compton distribution of complex gamma spectra in the energy range 0.04 to 1.4 Mev was obtained. (M.J.T.)

34568 SCINTILLATION gamma DOSIMETER. Kramer-Ageev, E. A.; Sakharov, V. K. pp 89-96 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

The operation of a sensitive scintillation gamma dosimeter with response compensated for spectral hardness is described. The response compensation for hardness of about 5% in the energy range from 50 kev to 3 Mev is achieved by the combination of an organic plastic crystal scintillator (p-terphenyl in polystyrene) with a KI(Tl) crystal. The scintillation dosimeter allows doses not significantly exceeding the natural background to be measured. (M.J.T.)

34569 MEASUREMENT OF FAST-NEUTRON DOSES. Leipunskii, O. I. pp 97-104 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

A short survey of existing methods of fast-neutron dosimetry is given, and the inadmissability of neglecting the contribution to the general neutron dose of the dose produced by the group of neutrons of intermediate energies (0.4 ev to 1 Mev) is demonstrated. It is shown that the failure to account for this contribution can entail a significant error in the determination of the total neutron dose. The development of methods and apparatus for the determination of intermediate neutron doses is formulated as the basic problem of neutron dosimetry. (M.J.T.)

34570 THRESHOLD DETECTORS FOR MEASURING FAST-NEUTRON FLUXES AND SPECTRA. Mashkovich, V. P. pp 105-14 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

A survey is given of work on the use of threshold detectors for the measurement of fluxes and spectra of fast neutrons; measurement of neutrons in the energy range 1 to 15 Mev using the reactions (n,α), (n,p), and (n,2n) is considered. As an example, results of measurements obtained on the BR-5 reactor are presented. (M.J.T.)

34571 PHYSICAL FOUNDATIONS FOR THE CONSTRUCTION OF HIGH-EFFICIENCY FAST-NEUTRON DETECTORS. Doroshenko, G. G.; Stolyarova, E. L. pp 115-24 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

The possibility of using methods of separate recording of fast neutrons and gamma quanta, based on the difference in effective de-excitation times of some organic phosphors as a function of the type of exciting particle, for the development of high-efficiency detectors is examined. Results of a literature survey of experimental data on the physics of processes in organic scintillators is given, and a classification of methods of separation of fast-neutron and gamma pulses is presented. (M.J.T.)

34572 CUT-OFF OF gamma BACKGROUND IN A HIGH-EFFICIENCY FAST-NEUTRON DETECTOR, USING SPACE CHARGE IN THE PHOTOMULTIPLIER. Doroshenko, G. G.; Stolyarova, E. L. pp 125-35 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

Methods for developing high-efficiency fast-neutron detectors with separate recording of neutron and gamma pulses are considered, based on the different effective de-excitation times of organic phosphors as a function of the exciting particle. Results of experiments on the physical peculiarity of a previously proposed separation method are presented. Experimental data are introduced on the variation of the saturation amplitude of the photomultiplier output signal with the scintillator de-excitation time and on the process of achieving a region of deep saturation of the photomultiplier by space charge. (M.J.T.)

34573 USE OF SPACE CHARGE AND GAS AMPLIFICATION IN A PHOTOMULTIPLIER FOR SEPARATION OF FAST-NEUTRON AND gamma PULSES. Doroshenko, G. G.; Stolyarova, E. L. pp 136-42 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

A method for improving the ratio of the saturation amplitude for fast neutrons to that for gamma quanta, using gas amplification in the photomultiplier, is introduced. Experimental data on achieving the region of gas amplification and confirming the presence of separation in this region are presented. (M.J.T.)

34574 EFFECT OF THE TEMPERATURE OF THE MEDIUM ON READINGS OF A SCINTILLATION COUNTER. THE EFFECT OF THE TEMPERATURE OF THE MEDIUM ON THE AMPLITUDE OF THE PHOTOMULTIPLIER OUTPUT SIGNAL. Stolyarova, E. L.; Soldaeva, L. S.; Suchkov, G. M. pp 143-55 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

Results are presented of a study of the temperature dependence of the amplitude of the photomultiplier output signal during illumination of the photocathode by fluorescence scintillations of glass from a generator of standard light pulses and by scintillator flashes arising in crystal scintillators gamma-irradiated with different doses at given distances. Experimental curves were obtained characterizing the contribution of the crystal and of the photomultiplier to the change of photomultiplier output signal for different temperatures. A scintillation counter with low sensitivity to temperature changes in the medium is proposed. (M.J.T.)

34575 ALIGNMENT AND CALIBRATION OF LONGITUDINAL MAGNETIC beta SPECTROMETER. Baronov, V. F.; Dmitrievskii, I. M.; Titov, B. G. pp 156-63 of

Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

The parameters of a longitudinal magnetic-lens beta spectrometer, without iron core, are described. A method for aligning and calibrating the spectrometer is proposed, and samples of resulting calibration curves and beta spectra are shown. (M.J.T.)

34576 SCINTILLATION COUNTER FOR ULTRAHIGH-SPEED NUCLEONS. Lebedev, V. N.; Salatskaya, M. I. pp 164-80 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

A neutron counter with threshold of 20.6 Mev, using the reaction $^{12}C(n,2n)^{11}C$, is described. A detailed account of the construction of the individual subassemblies and of the counter circuit is presented. The efficiency of detection of neutrons depends weakly on the energy for a wide range of energies. The counter permits a neutron flux equal to 1 n/cm^2 to be measured with statistical accuracy of 36%. The counter can find wide application for measuring dose fields of fast and ultrafast neutrons near high-energy accelerators. (M.J.T.)

34577 DEVICE FOR MEASURING COMPLEX gamma SPECTRA OF LOW INTENSITY. Stolyarova, E. L.; Chukhin, S. G.; Larichev, A. V. pp 181-5 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

A special device for measuring complex and continuous gamma spectra of low intensity is described, consisting of a scintillation gamma spectrometer with large NaI(Tl) crystal (80 × 80 mm) with replaceable collimators and specially developed shielding apparatus. The spectrometer has good resolution (9.5% for ^{137}Cs gamma rays) at high efficiency of recording (80% for 1-Mev gamma rays and not less than 50% for 10-Mev gamma rays) and possesses high stability. (M.J.T.)

34578 ON THE FUNCTION OF RESPONSE OF A SCINTILLATION SPECTROMETER TO gamma RAYS WITH MAXIMUM ENERGY OF 5 Mev. Larichev, A. V.; Cherevatenko, G. A.; Yakshin, V. V. pp 186-90 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

The response function of a scintillation gamma spectrometer with a NaI(Tl) crystal of dimensions 80 × 80 mm was obtained. The direct and inverse matrices of the response function, serving for the treatment of instrumental spectra, are set up. The accuracy of the construction of the matrices was verified experimentally by the example of the Ra spectrum. (M.J.T.)

34579 GAMMA-RAY SPECTROMETER FOR BALLOONFLIGHTS. Koehn, D.; Pinkau, K.; Wibberenz, G. (Universitat, Kiel). p.203-5 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

A gamma spectrometer consisting of a simple telescope on top of an absorber to measure the cascade energy is described. (D.C.W.)

34580 DETECTAREA SI MASURAREA RADIATIILOR NUCLEARE. (Detection and Measurement of Nuclear Radiation). Ciorascu, F.; Oncescu, M. [Bucharest], Editura Academiei Republicii Populare Romine, 1964. 276p.

A review is presented of detection methods and therefore no new nuclear phenomena or principles are described. However, study of radiation detectors requires a knowledge of the interaction between radiation and matter; the large number of phenomena which depend on the nature and the energy range of the radiation, is responsible for the great variety of detectors. A study of the detecting and measuring instruments alone is not sufficient; the auxiliary devices which pretreat the information furnished by the detectors and deliver it in a useable form must also be examined. This form may be a pulse, count rate or ionization charge. These systems are subject to statistical variations which are treated. The measurement methods are examined on the basis of the characteristic magnitude involved, such as count rate, dose, dose rate, activity, neutron flux, etc., dividing into radiometric, activity and dosimetric methods. The important problem of reference standards is critically examined. (TTT)

34581 IMPROVEMENTS IN OR RELATING TO GAMMA RADIATION MONITORS. Bisby, Harry; Seymour, Frank Daniel; Howard, Cecil Frederick (to United Kingdom Atomic Energy Authority). British Patent 989,647. Apr. 22, 1965. Filed June 27, 1962.

Apparatus for continuous monitoring of a liquid flowing in a process stream includes a gamma detector unit and a sample vessel so arranged that the detector receives radiation from the fluid but not from the walls of the vessel. The vessel is open-topped and frusto-conical in shape, the top being toward the open end of the vessel. The detector unit is cylindrical and is positioned above the vessel with a collimator tube between the detector and the vessel. A protective window of material substantially transparent to γ radiation is interposed between the collimator tube and the fluid sample. (A.G.W.)

34582 IMPROVEMENTS IN OR RELATING TO DOSIMETERS. Cooke-Yarborough, Edmund Harry (to United Kingdom Atomic Energy Authority). British Patent 990,192. Apr. 28, 1965. Filed May 21, 1962.

A dosimeter that gives an aural signal includes an ionization chamber having a polarizing electrode and a collector electrode. A potential difference initially established between the two electrodes decreases slowly when the ionization chamber is subjected to ionizing radiation. The potential of the polarizing electrode is caused to rise progressively until the potential of the collector electrode reaches a threshold value, at which point the aural signal is given and the potential of the polarizing electrode is returned to its initial value to recommence its rise. The time interval between signals decreases progressively until, at a predetermined dose, a continuous note is produced. (A.G.W.)

34583 IMPROVEMENTS IN OR RELATING TO SCINTILLATION DETECTORS. (to the Harshaw Chemical Co.). British Patent 994,879. June 10, 1965. Priority date July 6, 1960, United States.

A scintillation detector includes a transparent crystalline phosphor element of finite thickness having one end optically coupled to a photomultiplier tube. The detector is modified so that a light pulse produced by scintillation at a point on the crystalline element is received both directly and indirectly by the photocathode of the tube after reflection and/or scattering at or adjacent to the surfaces of the phosphor element. The transparent crystalline phosphor element is composed of a plurality of optically coupled crystal elements, and the external surfaces of the phosphor element are treated in some way to make them more reflective. This treatment may take the form of coating the surfaces with a diffuse reflective material, polishing the surfaces, or surrounding the element with a deflector. The reflectivity and/or scattering effect at a point on the surfaces is so dependent on the distances of such points from the photocathode that the intensity of the light pulse received at the photocathode resulting from the combination of both components is substantially independent of the position of the scintillation point in the phosphor element. (B.L.M.)

34584 IMPROVEMENTS IN OR RELATING TO CONTACT ELECTROMETERS. Ganouna-Cohen, Gilbert (to Commissariat a l'Energie Atomique). British Patent 995,055. June 10, 1965. Priority date Aug. 8, 1962, France.

A contact electrometer is described that is particularly useful for measuring weak electrical charges liberated in a detector having very high output impedance, e.g. an ionization chamber. The electrometer includes a first fixed armature or electrode connected to the collector electrode of the detector and a second electrode connected via an outer circuit including a resistor to one of the poles of a voltage source. The other pole of the voltage source is connected to the casing of the detector. A movable plate insulated from the electrodes is located between them in

such a way that when the poles and electrodes are connected it is attracted by each of the electrodes alternatively. Contact with one of the electrodes gives the plate the potential of the electrode so that it is repelled by that electrode and simultaneously attracted by the other electrode to propagate a pulse in the outer circuit for each contact of the movable plate with one of the electrodes. (B.L.M.)

34585 GAMMA RAYS DETECTOR. (to Socony Mobil Oil Co., Inc.). British Patent 995,886. June 23, 1965. Priority date July 7, 1961, United States.

A gamma ray detector particularly useful in connection with the logging of boreholes produces an output of electrical pulses having magnitude related to the energy of the gamma rays detected and includes a semiconductor diode having an intrinsic region disposed between the P-type and N-type regions that consists of or includes at least one element having an atomic number of 50 or greater. A source of voltage, connections to the P-type and N-type regions from the voltage source for backbiasing the diode, and an output circuit connected across the diode are also part of the detector. The intrinsic region of the diode is sufficiently thick, long, and wide to convert the annihilation quanta to electrons within this region, and its volume is more than twice the volume of each of the P-type and N-type regions. The intrinsic region consists of CdTe, Bi_2S_3, Bi_2Te_3, or Bi_2Se_3 if a pure gamma source is utilized; however, if a mixed source using both gamma rays and neutrons is applied, CdTe cannot be used as the material of the intrinsic region because of its high neutron-capture cross section. (B.L.M.)

34586 RADIOACTIVITY DETECTOR. Lubcke, Harry R. Canadian Patent 708,702. Apr. 27, 1965.

A transistor oscillator with variable resistors, an acceptor metal, and weak light irradiation are the adjustable parameters which inhibit oscillation of the circuit of the detector. Inhibition is decreased by radiation, and the amplitude of oscillation is a function of the intensity of radiation. Simplicity, compact size, low-voltage operation, high electrical output at low impedance, and application to well logging are among the advantages of this device. Radioactivities from a 0.1 μC to a gamma field of 10^5 R/hr can be detected. (F.S.A.)

34587 PERSONAL RADIATION WARNING DEVICE. Kerr, Howard S.; Driffield, John B.; Rowe, Ian H. (to The De Havilland Aircraft of Canada Ltd.). Canadian Patent 709,052. May 4, 1965.

A personal radiation warning device for radiation in the infrared spectrum is described, consisting essentially of a detector in the form of a silicon photovoltaic device, an alternating current amplifier for the detector signal, and means interposed between the detector and the alternating current amplifier for converting the incident energy to a series of pulses by a chopping action, the amplitude of the pulses being proportional to the intensity of radiation. (F.S.A.)

34588 DEVICE FOR CONTINUOUS MEASUREMENT OF NEUTRON FLUX. (to Groupement Atomique Alsacienne Atlantique). French Patent 1,357,745. Mar. 2, 1964. Filed Feb. 26, 1963.

To measure the neutron flux at different spots within a nuclear reactor, two gas streams pass through the reactor core. One of them passes through an activation space. The difference of the induced activities within the two gas streams is determined; the difference corresponds to the neutron flux within the activation space. The device for performing this method suitably comprises two identical pipelines of small cross section disposed side by side in parallel, one of them passing through the activation space, the two gas streams controlled to the same speed passing respectively through the two chambers of a differential ionization chamber. (I.I.B.)

34589 REMOTE RADIOACTIVE MONITOR AND TRANSMITTING MEANS. Wilcox, George E. U. S. Patent 3,178,577. Apr. 13, 1965. Filed Feb. 27, 1962.

A device is patented for detecting radiation and transmitting the information obtained to a remotely located station. The device includes an ionization chamber, rate meter circuitry for converting the ionization chamber output into a continuous electrical current varying with the radiation level, means for converting the electrical current into a transmittable signal, and means for transmitting the signal upon interrogation by a coded pulse received from the central monitoring station. A battery supplies electrical energy to the device, and a solar cell continuously recharges the battery. The entire unit is included in a housing designed to prevent accumulation of fallout upon it. A number of such units may be connected to one monitoring station. (A.G.W.)

34590 RADIATION DOSIMETER CIRCUIT. Bess, Leon. U. S. Patent 3,185,844. May 25, 1965. Filed Sept. 19, 1961.

A dosimeter is described that gives an accurate indication of both rate and total dosage of radiation absorbed by an individual during a given time interval. The output of the dosimeter takes the form of a pulse train whose repetition rate depends upon the intensity of radiation being monitored. The accumulated radiation is registered as a numerical count on a high speed pulse counter. The range of the dosimeter may be changed by switching into the circuit resistance and capacitance elements of different magnitudes. (B.L.M.)

34591 QUENCH CIRCUIT FOR RADIATION COUNTER TUBE. Leaver, Eric W.; Mounce, George R. (to Electronic Associates Ltd.). U. S. Patent 3,185,847. May 25, 1965. Filed Feb. 6, 1962.

A quench circuit for use with a radiation counter tube includes an electron tube having an anode, cathode, and grid and a source of operating potential having at least one high potential terminal and at least one low potential terminal. The cathode of the counter tube is connected through a resistor to one of the low potential terminals; the anode of the counter tube to one of the high potential terminals; and the anode of the electron tube to one of the high potential terminals. A resistance is included to provide a path for the anode currents of both the tubes. The cathode of the electron tube is connected to one of the low potential terminals so as to bias the electron tube for plate current saturation so that the anode to cathode potential of the counter tube is normally below the striking potential. Means are provided for coupling the counter tube cathode to the grid and for applying a negative gate pulse through the coupling means simultaneously to the grid of the electron tube and the cathode of the counter tube to cut off the plate current of the electron tube and to enable the generation of pulses by the counter tubes momentarily and immediately quenching each of the pulses. (B.L.M.)

Radiation Effects

34592 (EURAEC-1384) SOLID STATE NEUTRON DETECTOR. Final Report No. 2, October 1, 1963-September 30, 1964. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Contract 099-63-10-RDB. 64p. (EUR-2347) Dep.(mn); $3.00(cy), 2(mn) CFSTI

Work Performed under United States-Euratom Joint Research and Development Program.

The response to α particles of an americium and polonium source of SiC particle detectors upon reactor irradiation is studied. The change of the pulse-height, the I-V characteristics, the capacity vs. reverse bias, the short-circuit photocurrent and the open-circuit photovoltage upon reactor irradiation (BR1) were measured. Annealing studies were performed to 650°C. By comparing the calculated and the experimentally determined pulse-heights a relation is obtained between the lifetime of the charge-carriers and the fast neutron flux. Although the observations are too scanty to be decisive they seem to point to a simple radiation damage mechanism. Assuming that one kind of recombination center is formed, that the number of

recombination centers is proportional to the fast neutron flux and that the Fermi-level is not displaced upon irradiation. The term δ was calculated from the relation $\tau_i = [1/(\delta\phi + 1/\tau_0)]$. For detector CEN-4, which was irradiated at 80°C, δ is found to be 10^{-4} cm^2 sec^{-1}. For detector CEN-6, which was irradiated at 250°C, $\delta = 10^{-6}$ n_f^{-1} cm^2 sec^{-1}. The smaller value for detector CEN-6 may indicate that a simultaneous annealing of a part of the primary defects along with their formation upon irradiation occurs at 250°C in agreement with the observations. Heating to 650°C has no further effect. From the assumption that 100 recombination centers are formed per fast neutron per cm follows that for $\delta = 10^{-4}$ n_f^{-1} cm^2 sec^{-1} the capture cross-section for recombination of charge-carriers is 10^{-13} cm^2. For $\delta = 10^{-6}$ n_f^{-1} cm^2 sec^{-1} the charge collection-efficiency of a properly designed SiC particle detector will reduce to 10%, which is about equivalent to the noise-level, at 10^{15} nvt. (auth)

34593 (NP-15090) CHARGED PARTICLE RADIATION DAMAGE IN SEMICONDUCTORS. XI. EFFECTS OF LOW-ENERGY PROTONS AND HIGH-ENERGY ELECTRONS ON SILICON. Interim Technical Final Report. Carter, J. R.; Downing, R. G. (TRW Space Technology Labs., Thompson Ramo Wooldridge Inc., Redondo Beach, Calif.). May 4, 1965. Contract NAS5-3805. 57p.

Using Hall effects measurements, the electron energy dependence of the defect introduction rates of the $E_c - 0.17$ ev, $E_c - 0.4$ ev, and $E_v + 0.3$ ev levels was determined. The two levels at $E_c - 0.17$ ev and $E_c - 0.4$ ev were found to be relatively insensitive to incident electron energy. The defect introduction rate for the $E_v + 0.3$ ev level was found to increase rapidly with increasing electron energy and the energy dependence appears to be a function of material resistivity. At resistivities of the order of 15 ohm-cm the energy dependence of the defect introduction rate of the $E_v + 0.3$ ev level is identical to the observed energy dependence of the degradation of minority carrier lifetime in 10 ohm-cm n on p Si solar cells. Under low energy proton bombardment in the energy range from 0.2 Mev to 1.9 Mev the degradation rates of open circuit voltage, short circuit current and maximum power were much greater than normally observed for penetrating radiation. The maximum sensitivity of absolute power degradation of Si solar cells appears to lie at or slightly above 2 Mev with decreasing sensitivity evidenced at energies below 2 Mev and above 6 Mev. Considerable room temperature annealing was observed for low energy proton damaged cells. One Mev electron irradiation of 1 ohm-cm and 10-ohm-cm B doped and Al doped n on p Si solar cells indicate that the differences in radiation sensitivity as measured by K values cannot be attributed to the dopant material. It was observed that differences in K values were greater between specimen lots than between the differently doped specimens of equal resistivities, suggesting that fabrication techniques or differences in bulk material trace impurity content may be responsible for the observed small differences in radiation sensitivity. (auth)

ISOTOPE TECHNOLOGY

General

34594 ISOTOPES DEVELOPMENT RESEARCH. p.85-96 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Progress is reported in uses of isotopes, including: process radiation development; radioisotope technology development; and radioisotope production and separation. (T.F.H.)

Industrial Applications

34595 (COO-1318-1) 90-DAY SUBACUTE ORAL TOXICITY STUDIES ON RADIATION-PASTEURIZED FOODS (STRAWBERRIES, APPLES AND PEARS). Final Report. Calandra, J. C.; Ives, Margaret (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). [nd]. Contract AT(11-1)-1318. 143p. Dep.(mn); $4.00(cy), 3(mn) CFSTI

Dogs and rats were fed diets containing radiation-processed apples, pears, and strawberries for 90 days. Data are presented on the food consumption, growth, mortality, reactions, hematology, urology, blood chemistry, enzyme studies, and gross and microscopic pathological studies of the animals throughout the test period. No indication was found of a toxic effect of the irradiated fruits in the diet. (C.H.)

34596 (NYO-3274-2) BIOCHEMISTRY AND PHYSIOLOGY OF IRRADIATED FRUITS AND VEGETABLES. Annual Progress Report, September 4, 1964-September 3, 1965. Massey, Louis M. Jr. (New York State Agricultural Experiment Station, Geneva). May 31, 1965. Contract AT(30-1)-3274. 42p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Results are reported from a study of radiation-induced changes in intermediary metabolism, particularly the citric acid cycle. This was accomplished by introducing differentially labeled glucose, pyruvate, and acetate to treated tissues and comparing the metabolic fate of these compounds to appropriate control tissues. Several experiments were conducted which investigated the effect of radiation on the substrate and media used in the metabolism experiments. It was found that even at extremely high doses there was no effect of the irradiated media components on metabolism. If however, the substrate (in this case glucose) were irradiated and then used in the metabolism experiments, there was a significant alteration of metabolic reactions. The absorption of pyruvate was found to be decreased by low doses of γ radiation and increased with high doses. There was only a slight effect on the decarboxylation of pyruvate. However radiation did reduce the incorporation of substrate into carrot tissue components. The absorption of acetate was affected by radiation but in a reverse manner than was pyruvate or glucose. Analysis of the organic acids revealed a radiation-reduced incorporation of acetate label into citrate, isocitrate and (in the case of two-labeled acetate) malate. Free substrate was found to increase sharply, particularly at the higher doses. Analysis of free amino acids indicated that the incorporation of acetate label into amino acids in irradiated tissue depended on the type of amino acid. Incorporation into basic amino acids was minor while all the acidic amino acids (with the exception of glycine and leucine) were significantly reduced. Analysis also revealed a significant destruction of amino acids in the tissue due to radiation. The incorporation of acetate into lipids was affected by radiation. However, this effect decreased or increased dependent on the type of lipid material or the label. Analysis of fatty acids showed a rather large radiation sensitivity of acetate-1-C-14 incorporation into fatty acids while the sensitivity of incorporation of acetate-2-C-14 was somewhat smaller. While the total label recovered from fatty acids was reduced by irradiation, the label appearing in phospholipids and hydrocarbons was increased. (C.H.)

34597 POSSIBILITIES OF THE APPLICATION OF SOFT X-RAYS FOR THE IRRADIATION OF FOODS. Gruenewald, Th. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Atomkernenergie, 10: 211-14(May-June 1965). (In German)

The surface irradiation of foods becomes more and more important, as by this procedure a limited region can be irradiated with high doses, whereas the mean dose remains small. Therefore, the efficiency of a soft x-ray generator suitable for the surface irradiation with differently filtered rays was determined and compared with that of a cobalt γ source. For a surface irradiation the x-ray generator was found to be superior to the cobalt γ source because of the easy adjustability of the penetration depth and its high dose rate, but there were difficulties regarding the calculation of the dose and the dose distribution. Formulas are given for calculation of the dose for irradiation with x rays from various directions. (auth)

34598 EFFECT OF THE GAMMA-RAY IRRADIATION ON THE REMOVAL OF ASTRINGENCY IN KAKI (ORIENTAL PERSIMMONS). Kitagawa, Hirotoshi (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 43: 60-3(Jan. 1965).

The effects of gamma rays from ^{60}Co on the removal of astringency in Kaki (oriental persimmons) were observed. The astringency of mature Kaki fruits was removed completely by irradiation with gamma rays to a dosage of more than 150×10^4 r. As the radiation dose was increased, firmness and astringency decreased while soluble pectin increased. The fruit in which astringency was removed by this treatment became soft as the overripe fruit. The gamma irradiation seemed to accelerate the ripening of the fruit. From the data obtained on firmness, and alcohol, acetaldehyde, and water-soluble pectin contents of the fruit, and microscopic observation of its tannin cells after the irradiation, it was concluded that the mechanism of removal of the astringency is the same as in overripe fruits. (auth)

34599 IRRADIATION: BIG ADVANCE IN PRESERVING SEAFOOD. Kaylor, John D.; Slavin, Joseph N. (Bureau of Commercial Fisheries Technological Lab., Gloucester, Mass.). Fishing News Intern., 4: 147-51(Apr.-June 1965).

An illustrated description is given of the construction and operation of the new Marine Products Development Irradiator (MPDI) at Gloucester, Massachusetts. The MPDI facility was built by the Atomic Energy Commission and will be operated by scientific personnel of the Bureau of Commercial Fisheries as part of their research program on the preservation of sea-foods by the use of pasteurizing doses of γ radiation from ^{60}Co. The Gloucester facility can produce 1 ton of pasteurized product an hour with its 250,000-C ^{60}Co source. The heart of the irradiator is a massive-walled 5-ft-thick concrete structure. There is also a refrigerated area and a unique product conveyor that carries packages of fish to be irradiated through an underground labyrinth and then up into the radiation cell. After passing through the irradiator, the fish fillets are still fresh, raw, and cold when they emerge. The surviving bacteria, about 1% or less of the initial number present, are still capable of reproduction. Irradiated fillets and shellfish must therefore be kept refrigerated to retard bacterial growth. Fish so treated are still fresh, but their storage life, which varies with the type of fish, becomes double or triple that of identical nonirradiated fish because most of the bacteria have been killed. It has been established that 13 major species of fish and shellfish have prolonged refrigerated storage life after being pasteurized with low levels of radiation. At dose levels of less than 500,000 rad, the normal refrigerated shelf life of shrimp, haddock, cod, ocean perch, flounder and sole,

halibut, pollock, soft-shell clams, Dungeness crab, king crab, and yellow perch is doubled or tripled when kept at 33°F. Like any other fresh products, however, storage at higher temperatures reduces shelf life. Irradiated fish and shellfish stored at 42°F, for example, spoil about twice as fast as those stored at 33°F. The age or quality of the raw material used for irradiation also directly affected the quality and shelf life of the irradiated product. Fish kept 7 to 9 days are not suitable for irradiation. The type of package used also has an influence on the keeping quality of the irradiated seafood. Products packaged in flexible films of high permeability to oxygen have a slightly shorter shelf life than those enclosed in air-tight packages. In large-scale feeding tests with U. S. Army soldiers it was found that the irradiated haddock, shrimp, and petrale sole compared favorably with fresh frozen controls in acceptability. Operation of MPDI is described as well as its general layout. Conveyors transport the product into and out of the cell area; each tray of the conveyor holds two 30-lb tins of fish. The high-speed conveyor moves these trays through a labyrinth into the irradiation area, where the trays are transferred to a horizontal conveyor and moved past the ^{60}Co source. Each package is passed by the source four times in order to ensure that it receives the required dose of radiation. Fish that are to receive 250,000 rad remain in the irradiation area for one half-hour. In operating the irradiator the cell area is first closed off, and the source is raised from a pool of water 15 ft deep, and sandwiched between the incoming and outgoing tracks of the food conveyor. The MPDI cost $600,000 completed, and the 250,000 C of ^{60}Co which has a half life of about five years, cost about 50¢/C. Three operators are required per shift, plus a maintenance man and a general supervisor for the day shift. At an annual average production of 6300 tons of fish per year, processing costs would approximate $38 per ton, or 1.9¢ per lb of irradiated fish. If production is reduced to one-half of this figure, costs will almost double because of the high ratio of fixed costs to labor. These preliminary figures indicate that the economics of radiation pasteurization are more favorable than the economics of either freeze drying or freezing with liquid nitrogen. (BBB)

34600 EXTENSION OF STORAGE LIFE OF CITRUS FRUIT BY IRRADIATION. Kahan, R. S. (Soreq Research Establishment, Rehovoth, Israel); Monselise, S. P. Food Technol., 19: 122-4(Feb. 1965). (IA-808)

Valencia-type oranges were artificially infected with Penicillium digitatum spores and subjected to doses of 45 to 175 krad of ^{60}Co γ rays. The unirradiated, inoculated control fruits were rotten 4 to 5 days after inoculation and storage at 4 to 6°C. The increase in storage life reported is for fruit inoculated after 10 to 14 weeks of cold storage. A linear relation was found between shelf life and the surface irradiation dose over the range of 45 to 175 krad. Each 14.1 krad gave an additional day of storage life for the range tested. When fresh fruit was used instead of material from cold storage, much longer increases in shelf life were obtained for a given radiation dose. Thus, with Shamouti oranges picked 2 to 3 days before inoculation, much of the fruit remained in good condition for at least 80 days after doses of 100 to 250 krad. Furthermore, doses of only 2.5 to 4.5 krad, administered 24 hr after inoculation, delayed the appearance of rot by several days. The rot appeared 7 to 14 days after inoculation, compared with 3 go 4 days for controls. For cold-storage Valencia fruit, 50-krad doses were required to obtain a delay of 7 days. Peel thickness and composition of the two orange varieties are quite different, and this also could have influenced the reaction of the fruit to radiation. It is probable that, by shortening radiation times and lowering the storage temperature from 20 to 25° to 10 to 15°, the storage life extension caused by a given dose could be increased. Also studied was irradiation of uninoculated ripe oranges drawn from cold storage after 10 to 14 weeks. The fruits were treated with six different doses in the 100 to 360-krad range and then stored at 25° for a further six weeks. There were no externally visible radiation effects, and the shrinkage and loss in weight were similar to those of the controls. No differences were found, compared with controls, in vitamin C content and the respiration rate of fruit irradiated with 150 krad, when determined on segments of the fruit. (BBB)

34601 PHYSICAL AND SENSORY TESTS ON FRESH STRAWBERRIES SUBJECTED TO GAMMA RADIATION. Johnson, Carol F.; Maxie, E. C.; Elbert, Elizabeth M. (Univ. of California, Davis). Food Technol., 19: 119-23 (Mar. 1965).

Fresh strawberries of the Shasta and Lassen varieties were subjected to pasteurization levels of ^{60}Co γ radiation applied in conjunction with accepted commercial procedures of temperature and handling. The fruit was evaluated for texture, flavor, aroma, and general appearance. Objective measures of texture were made with the Kramer shear press, and sensory analyses were conducted in triangular tests. Objective measurements showed that berries became progressively soft as the dose increased from 100 to 400 krad. The strawberries became more resistant to crushing (i.e., tougher) with storage periods of 10 days. This toughening effect was not prevented by reducing water losses through storing the fruit in vented polyethylene bags. Sensory evaluation of strawberries irradiated at 0, 100, 200, and 300 krad revealed only small differences in flavor. Differences in appearance, aroma, and texture were greater, though not objectionable. The irradiated strawberries were rated lower for appearance than for any of the other attributes. The exterior of the irradiated strawberries was dull, and a watery appearance was evident at 300 krad. The interior of sliced, irradiated berries was also watery, with a dull, grayish-brown color appearing in the white flesh near the center of the fruit. Irradiation harmed aroma less than the other attributes. It is concluded that γ irradiation at levels as high as 200 krad caused only minor deleterious effects on the appearance, aroma, flavor, and texture of strawberries. This dose is effective in controlling transit decay in strawberries. Berries given such low levels of irradiation would likely be more appealing to the consumer than berries containing a high percentage of decay. (BBB)

34602 RADIATION PASTEURIZATION OF RAW AND CHLORTETRACYCLINE-TREATED SHRIMP. Awad, A. A.; Sinnhuber, Russell O.; Anderson, A. W. (Oregon State Univ., Corvallis). Food Technol., 19: 182-4(May 1965).

The storage life of raw shrimp was extended with pasteurizing doses of ionizing radiations in combination with storage at 38°F and chlortetracycline (CTC). Levels of irradiation that did not produce significant organoleptic changes in raw shrimp were determined to be 0.5 and 0.75 Mrad. Irradiated and unirradiated samples were stored 10 weeks and compared at intervals for changes in quality. Analytic methods included: organoleptic, microbiological, and chemical tests. Storage life of shrimp irradiated at 0.5 Mrad was extended to five weeks, compared with one week for the unirradiated samples held at the same temperature. During an 8-to-10-week storage period, samples receiving doses of 0.5 Mrad with CTC and those receiving 0.75 Mrad, with and without CTC, remained in good condition. There was an increase and a subsequent decline of microorganisms in the irradiated raw shrimp at 0.5 Mrad. Samples receiving 0.5 Mrad plus CTC showed a decrease in total culture plate count. In samples treated with 0.75 Mrad, the total count was insignificant (less than 1000/g). In almost all cases, the irradiated samples after 10 weeks at 38°F gave chemical results equal to, or less than, the values of the unirradiated samples after one week. Radiopasteurization effected a 4- to 5-fold extension of storage life based on a flavor preference test. It was found that CTC treatments have an effect complementary to that of radiation and yield a more desirable product, a phenomenon that was dose dependent. (BBB)

34603 THE PROPERTIES OF CATGUT SUTURES STERILIZED BY HEAT, ETHYLENE OXIDE, AND ELECTRON BEAMS. Thoennes, L. A. J. Intern. Coll. Surgeons, 42: 382-6(Oct. 1964).

Studies were conducted on methods of sterilization of

catgut. Heat or electron beams caused significant changes in collagen molecules and a corresponding loss in tensile strength. Ethylene oxide produced minor changes in collagen molecules, but did not produce loss in tensile strength. These results indicate that sutures sterilized with ethylene oxide are superior to those sterilized by heat or electron beams and offer the greatest margin of safety to the surgeon. (BBB)

34604 MEASURING SYSTEM PROVIDING A BEAM OF BREMSSTRAHLUNG RAYS FROM A COMPOSITE RADIATION SOURCE. Handel, Neil E. (to Industrial Nucleonics Corp). Canadian Patent 709,929. May 28, 1965.

An apparatus for producing pure beams of electromagnetic radiation from composite beams is described in conjunction with a thickness measuring gauge. γ rays from a radioisotope, on passing through a target, are converted to bremsstrahlung. A detector measures the energy absorbed by the material, thereby indicating its thickness. By placing the detector at one side of a thin target, the γ rays, which pass straight through the target, do not contaminate the bremsstrahlung radiation which issues in all directions. More sensitive measurements of light and intermediate weight materials, simple and inexpensive construction, and economical maintenance are among the advantages claimed. (F.S.A.)

34605 IRRADIATION OF LUBRICATING OILS. Hunphrey, Earl L.; McGrath, Joseph J. (to Gulf Research and Development Co.). U. S. Patent 3,153,622. Oct. 20, 1964. Filed Oct. 27, 1959.

A process is described for preparing a lubricating oil having a relatively low tendency to deposit coke as determined by the Panel Coking Test that includes subjecting a hydrogenated lubricating oil having a viscosity between 50 and 150 S.U.S. at 210°F to ionizing radiation of between 0.001 and 10.0 whr/g. The irradiation is carried out at ambient temperature and pressure; and the oil may be passed through a pipe that is exposed to and is transparent to the radiation, may be passed in the form of a thin film over a surface that is subjected to the radiation, or may be placed in reservoirs or pans and then conveyed through the ionizing radiation by means of an endless belt. The irradiated oils are particularly suitable for lubricating aircraft turbines and the like. (B.L.M.)

Power Application

34606 ISOTOPIC SOURCE OF ELECTRIC POWER BETA-2. Fradkin, G. M.; Kodyukov, V. M.; Ragozinskii, A. I. At. Energ. (USSR), 18: 545-6(May 1965). (In Russian)

The installation Beta-2 is designed for an automatic radiometeorological station power supply for operation without servicing for 10 years. The station is capable of measuring and transmitting by radio, at a distance of 600 km the rate and direction of wind, air pressure, temperature, and the amount of precipitation. Strontium-90 is used as the radioactive substance working in a hermitically closed cylindrical container (350 mm in diameter and 400 mm high). The weight of the container is 150 kg, effective dose at 1 m distance is about 1R/hr, and the electrical power is 5 to 7 w. (R.V.J.)

Separation and Production

See also CHEMISTRY — Separation Processes and Procedures.

Refer also to abstracts 34829, 35510, and 35511.

34607 (MLM-1239) STATUS OF STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION AT MOUND LABORATORY-1963. Haubach, W. J.; Eck, C. F.; Rutherford, W. M.; Taylor, W. L. (Mound Lab., Miamisburg, Ohio). Dec. 31, 1963. Contract AT-33-1-GEN-53. 80p. Dep.(mn); $3.00(cy), 2(mn) CFSTI

An account is given of work which was carried out in 1963 in the investigative program on isotope separation. The work includes carbon isotope separation; helium-3 separation, purification, and research; neon isotope separation; argon isotope separation; krypton isotope separation; xenon isotope separation and purification; and thermal diffusion research. (D.L.C.)

34608 INITIAL MEASUREMENTS WITH A.W.R.E. ISOTOPE SEPARATOR. Freeman, N. J.; Pagden, I. M. H. (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). 12p. (CONF-578-7). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

The A.W.R.E. isotope separator is a 90° sector machine of radius 100 cm. The machine was designed with a high vacuum ($\sim 10^{-7}$ mm of Hg), a maximum acceleration voltage of 70 kv and a maximum beam current of 1 ma. A value of 1000 was expected for both the resolving power and the enrichment factor. Argon, krypton, and carbon monoxide gases were used for measurements on the resolving power and beam current. Focused beams of 10 to 200 μa were extracted from the Unoplasmatron source with 0.75 mm and 1.5 mm diameter exit apertures and the corresponding resolving powers ranged from 3000 to 250. Efficiency estimates were somewhat lower than expected, being about 3% at the highest current. Higher efficiencies of 5-10% were recorded with a Nielsen type source using gas and lead chloride samples. A 1.5 mm diameter source aperture is normally used and beams up to 50 μa can be focused with resolving powers between 2000 and 3000. The tails of the mass lines are slightly larger than those measured with the Unoplasmatron source (i.e., a factor 2 increase in line width at 5% of full height). Below 50 μa the effect of compression on resolution is slight, and the beam height can be reduced from 40 mm to 2 mm. While the resolving power changes from 2500 to 2000, a number of Sm-149 samples have been separated for neutron cross section measurements. In this type of work the technique involving the direct collection of the focussed ions on a mass spectrometer filament is highly favoured since the samples can be analysed, irradiated and reanalysed without introducing contaminants by chemical extractions. Sufficient sample for mass analysis can be collected in a few minutes with a Sm-149 beam of 5 μa focussed on to a 5 mm × 1 mm slit, and relative enrichment factors greater than 1000 are readily obtainable. Preliminary measurements of the effect of pressure in the system on the tails of the Samarium mass lines indicate that the contribution to adjacent masses is doubled for a pressure rise of 5×10^{-7} to 5×10^{-6} mm of Hg. (auth)

34609 PREPARATION OF A Na-24 SOURCE FOR A MAGNETIC beta-SPECTROMETER. Paul, H.; Viehboeck, F. P. (Osterreichische Studiengeseilschaft fur Atomenergie, Vienna). 5p. (CONF-578-14). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

The shape of the Na-24 β spectrum was previously found to have no or small deviations from the statistical shape. The accuracy of this measurement was limited by the low specific activity available. Sources were prepared by activating Na_2CO_3 in a reactor and separating the Na-24 afterwards in the mass separator. The results are discussed. (auth)

34610 STICKING FACTORS FOR RARE GAS IONS IN VARIOUS METALS. Brown, F.; Davies, J. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 9p. (CONF-578-16). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

When an electromagnetic isotope separator is used to process rare gases, the ions which strike the collecting foil are not necessarily retained completely. The fraction retained is referred to as the sticking factor. Experiments have been conducted with Xe and Ar ions in the energy range 0.1 to 180 kev and with collecting foils of Be, Al, Ni, Zr, Ag, Ta and Au. Separated beams of

^{125}Xe, ^{133}Xe or ^{41}Ar were used and the bombardment times were small, in the order of a few minutes, whereby saturation and sputtering effects were avoided. In most metals the sticking factor was essentially unity at all energies greater than 5 kev but fell rapidly below 5 kev to become essentially zero at 0.1 kev. In Ag and Au the sticking factors were lower at all energies, for example Au gave 0.8 at 45 kev, and only approached unity for energies in the order of 100 kev. Low sticking factors are caused by diffusion of the gas out of the targets and the low sticking factors for Ag and Au are thought to be associated with the relatively high mobility of the atoms in these metallic lattices and to the absence of oxide layers on their surfaces. (auth)

34611 OPTIMUM CHOICE OF IRRADIATION AND SEPARATION TIME FOR PRODUCTION OF RADIOACTIVE SOURCES. Paul, Helmut (Osterreichische Studiengesellschaft fuer Atomenergie, Vienna). 7p. (CONF-578-12). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

The strength of a source produced by reactor (or accelerator) irradiation and subsequent mass separation depends, at a given neutron flux and a given separator current, upon irradiation time and separation time. It is shown that a certain choice of these times yields the maximum source strength for any given total time. (auth)

34612 PERFORMANCE OF RISC (THE RADIO ISOTOPE SEPARATOR AT CERN). Andersson, G. (Centre Europeen de Recherches Nucleaires, Geneva). 18p. (CONF-578-9). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

The separator, which was put into operation at the end of last year, is based on a fringing field-focusing principle. It proved possible to realize the desired field shape to a very good approximation by means of iron flanges forming part of the acceleration and dispersion chambers. Neither additional shimming, nor the use of electrostatic depression was necessary in order to obtain two-directional focusing over a ± 10% relative mass difference. The resulting focal spots are nearly circular and have a half-width of the intensity distribution of down to about 1mn at modest ion currents (I_{total} of the order of 100μA). In application to high energy fission studies (2) the contamination of neighboring masses (with no space between the collectors) has been below 0.5% with iodine. (auth)

34613 ION BEAM FORMATION IN THE PRETORIA ISOTOPE SEPARATOR. Rautenbach, W. L. (National Physical Research Lab., Pretoria). 7p. (CONF-578-2). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

Experience with the laboratory electromagnetic separator in Pretoria shows that its performance can be considerably improved by employing ion beams from convex plasma boundaries instead of the usual beams from concave boundaries. This was traced to the different radial charge distributions in the two types of beams. In the case of ion beams from a concave boundary the charge distribution has a gaussian shape but is practically square for beams from convex boundaries. In the last case the effect of the space charge repulsion in the beam will therefore be similar to that of a diverging lens with little aberration. For beams from concave boundaries, however, the space charge will cause serious aberration. Therefore the effect of space charge repulsion in the ion beam of the isotope separator between the focusing system and the magnet cannot be compensated by over-focussing of the beam in the case of beams from concave boundaries without giving diffuse mass lines at the collector. For ion beams from convex plasma boundaries it is possible to compensate the effects of space charge repulsion in this way without undue loss of resolution in the mass lines at the collector. A possible explanation for the difference in the charge distribution in the two types of beams will be presented. (auth)

34614 SOME CHARACTERISTICS OF THE SGAE ELECTROMAGNETIC ISOTOPE SEPARATOR. Viehboeck, F. P.; Buschbeck, F. (Osterreichische Studiengesellschaft fuer Atomenergie, Vienna). 11p. (CONF-578-5). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

The Electromagnetic Isotope Separator of the SGAE is a medium size machine, with a 180° inhomogeneous magnetic sector field and a mean radius of 1 m. Some constructional details of the machine will be discussed. Also, some details about the electronics will be given, especially on regulating systems. First results about the resolving power obtained with a thermionic source and an arc discharge source will be shown. Also some numerical results concerning the enrichment factor estimated with a radioactive isotope will be given. (auth)

34615 THE INFLUENCE OF THE SPHERICAL ABERRATION ON THE IMAGING OF THE ELECTROMAGNETIC ISOTOPE SEPARATOR AND THE REALIZATION OF AN OPTIMAL LENS SYSTEM. Delgmann, L.; Wagner, H.; Walcher, W. (Universitaet, Marburg, Ger.). 7p. (CONF-578-3). ORINS.

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

It is shown theoretically that a lens having a small aberration will also have a small constant of aberration. This is an advantage since the lower the aberration constant the smaller may be the lens system and the shorter the rays. A lens was developed which showed a reduction of the aberration by a factor of two compared to the former lens, although it caused a gas discharge and so had to be used under different conditions. This discharge is also described. Diagrams of the lens arrangement are included. (J.F.P.)

34616 BEAM RETARDING TECHNIQUES FOR THE PREPARATION OF SOURCES FOR β-RAY SPECTROMETRY. Brown, F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 10p. (CONF-578-4). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

When an electromagnetic isotope separator is used to prepare sources for the precision spectroscopy of low-energy conversion electrons, the resolution of the spectrometer is seriously affected by the penetration of the collected ions into the source backing material. It is therefore essential to retard the ions in the mass separator prior to their collection in order to minimize penetration. It is also advantageous to have the separator produce a very narrow line source. A description is given of simple systems for retarding ions and it is shown that the final ion energy can be reduced to 1.0 kev and that the source width can be reduced under favourable circumstances, to about 0.2 mm compared to about 1.0 mm obtained without the retarding system. Sources of ^{125}Xe were prepared for use in the Chalk River β spectrometer and a systematic investigation of the effect of ion collection energy on the shape of the K-55 conversion line was made. (auth)

MATHEMATICS AND COMPUTERS

Refer also to abstract 34784.

34617 (HMI-B-40) UBER DIE TSCHEBYSCHEFFSCHE APPROXIMATIONSAUFGABE BEI NICHT ERFUELLTER HAARSCHER BEDINGUNG. (The Chebyshev Approximation Problem in the Non-Fulfilled Haar Condition). Toepfer, H.-J. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Mar. 1965. 65p. Dep.(mn).

Thesis submitted to Technische Universitaet, Berlin (West Germany).

The Haar hypothesis is assumed and the resulting situation is systematically investigated. In order to obtain a closed representation of the theory, some principles are formulated and proved. Some necessary norm-specific basic facts of approximation theory are first compiled. These are then specialized to the Chebyshev approximation, and a general definition of the reference concept is given. Reference functions and alternants are treated. The Stiefel exchange method is accordingly generalized. (J.S.R.)

34618 (LA-DC-6526) THE THEORY AND APPLICATION OF THE PADE APPROXIMANT METHOD. Baker, George A. Jr. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 112p. Dep.(mn); $4.00(cy), 2(mn) CFSTI

The convergence properties of sequences of Padé approximants are discussed. One primary application of Padé approximants is to obtain quantitative information about functions which are known only from their power series and qualitative behavior. A number of these simple applications to various physical problems are reviewed. Finally, the generalization of the Padé approximant method to include power series coefficients at more than one point is discussed. (M.O.W.)

34619 (LA-DC-6544) FIBONACCI SPACES. Cashwell, E. D.; Everett, C. J. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1963]. Contract W-7405-eng-36. 24p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

The Fibonacci sequence $\{u_j\} = \{0,1,2,3 \ldots\}$ with $u_j + u_{j+1} = u_{j+2}$, $j \geq 0$, is regarded as one element of a certain space of sequences associated with the quadratic $f(x) = \overline{-1} - x - x^2$. An analysis is presented in general form. (M.O.W.)

34620 (WAPD-T-1712) ON ESTIMATION OF THE SUCCESSIVE OVER RELAXATION FACTOR. Rigler, A. K. (Bettis Atomic Power Lab., Pittsburgh, Pa.). June 1964. Contract AT-11-1-GEN-14. 10p. Dep.(mn); $1.00 (cy); 1(mn) CFSTI.

Successive over relaxation is a method for solving finite difference equations of elliptic type. In the estimation of the spectral radius ρ of the basic simultaneous displacement iteration matrix, the use of a slightly larger value is less serious than an estimate which is too small by the same amount. It is shown how to take advantage of this fact by using the Kohn-Kato formula for an upper bound. Two examples are given. (D.L.C.)

34621 (WAPD-T-1764) APPROXIMATE METHODS FOR SOLVING LINEAR AND NON-LINEAR MULTIDIMENSIONAL INTEGRAL EQUATIONS AND BOUNDARY VALUE PROBLEMS (thesis). Itkin, Ivan (Pittsburgh Univ., Pa.). 1964. Contract AT(11-1)-Gen-14. 297p. Dep.(mn); $6.00(cy), 5(mn) CFSTI.

Approximate methods are presented for solving general forms of integral equations, linear or non-linear, possessing an arbitrary finite number of dimensions adaptable to electronic digital computation. The major emphasis is placed upon developing and classifying methods which can be applied to multidimensional non-linear integral equations. Included is a discussion of replacement formulas for integrals, and an examination of the stability characteristics of a step-by-step process for solving integral equations with variable limits. General classes of steady-state and time-dependent boundary value problems are shown each to possess a compact representation in the form of an integro-differential equation which includes the boundary conditions. Appropriate methods are discussed for obtaining their solutions. This representation has the advantage of providing solutions for any simply closed analytic region and is not restricted, as it would be in differential form, to simple geometries. It has also been suggested that discrete variable methods of solution are more stable when applied to integral rather than differential forms of boundary value problems. (auth)

34622 ASYMPTOTIC EXPANSIONS OF SOLUTIONS OF DIFFERENTIAL EQUATIONS. Fikioris, J. G. (Harvard Univ., Cambridge, Mass.). J. Math. Phys. (N. Y.), 6: 1131-48(July 1965).

A generalization of Ford's method, concerning the asymptotic expansions of solutions of differential equations with polynomial coefficients and with three or more regular singular points and one irregular at infinity, is presented. The analysis is subsequently extended to the special case of integral values for the difference of exponents of the differential equation, thus providing the complete asymptotic expansion of the second, logarithmic solution of the equation. Explicit formulas for the evaluation of the constant coefficients of the expansions are given; each coefficient is expressed in terms of a single solution of the adjoint difference equation associated with the original differential equation. Differential equations possessing singularities in excess of the hypergeometric equation (3 regular) or its variations, appear as separated solutions of the wave equation in certain stratified media whose index of refraction is a continuous function of position. (auth)

34623 THE MATRIX ELEMENT OF SPACE GROUP OPERATORS. Hsu, Chih-chung; Hsieh, Hsi-teh (Fudan Univ., China). Wu Li Hsueh Pao, 21: 802-16(Apr. 1965). (In Chinese)

It is shown that in the direct product of two wave vector stars $k \otimes k'$, if $k'' \in k \otimes k'$, the wave vector group, $G_{k''}$, may belong to any one of the following cases: both G_k and $G_{k'}$ are subgroups of $G_{k''}$; $G_k = G_{k'} = G_{k''}$; $G_{k''} = G_s$; G_s is the subgroup of $G_{k''}$. The reduction of an integral $A = \langle f^{i''}_{\mu''}(k'') | f^{i}_{\mu}(k) | f^{i'}_{\mu'}(k') \rangle$, is then studied for each of the four cases. It is found that for all cases, the value of the integral can be expressed in terms of the matrix element of a transformed matrix U by which the reducible representation has been reduced. The corresponding reducible representations Γ's are respectively: $(\Gamma^{i}_{k} \otimes \Gamma^{i'}_{k'})^{\vartheta}$; $\Gamma^{i}_{k} \otimes \Gamma^{i'}_{k'}$; $\Gamma^{i(s)}_{k} \otimes \Gamma^{i'(s)}_{k'}$; and $(\Gamma^{i(s)}_{k} \otimes \Gamma^{i'(s)}_{k'})^{\vartheta}$. The final form of the integral is then obtained by finding the explicit form of the transformation matrix by using the pseudo-projection operator. (auth)

34624 MATHEMATICS AND COMPUTER RESEARCH. p.29-35 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

The development of computers and programs for physics research uses is outlined. The results of a hydrodynamic-theory computer code in predicting meteorological phenomena are shown as an example. (T.F.H.)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstracts 34801, 35603, 35608, and 35613.

34625 (AD-612912) ELECTRON FRACTOGRAPHY HANDBOOK. Final Report, May 10, 1963–January 31, 1965. Whiteson, B. V.; Phillips, A.; Kerlins, V. (Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.). Contract AF33(657)-11127. 910p. (ML-TDR-64-416) $12.10(CFSTI).

A handbook on electron fractography is presented, covering techniques, fracture modes, and environmental effects on fracture appearance. Fractographs for over 300 specimens that failed under known conditions are included. (D.C.W.)

34626 (BNWL-79) METALLURGY RESEARCH OPERATION. Quarterly Progress Report, January–March 1965. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 15, 1965. Contract AT(45-1)-1830. 103p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

Separate abstracts were prepared for the four sections of the report. (W.L.G.)

For abstracts of individual sections see: 34627, 34639, 34741, and 34742.

34627 (BNWL-79(p.6.1-20)) MATERIALS ENGINEERING. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A high temperature gas loop heater designed to incorporate and investigate essential details of a compact two-stage heater for the ATR Gas Loop is described. A bypass He purification system utilizing pressure drop available from the gas bearing compressor was installed. Purity levels of less than 0.1 ppm for all species except water, which was 3.5 ppm, were achieved at a loop temperature of 916°C. The results of bend and tensile tests of weld metals and base metals aged 500 hr suggest that Hastelloy W has better aging characteristics than Hastelloy-X when used as filler wire for joining Hastelloy X-280 to AISI 316 stainless steel and Haynes 25. This suggestion is based on consideration of the weld metal yield stress being larger than the base metals yield stresses, the relative sluggishness of weld metal aging, and the amount of useful ductility remaining in the weld metal and the base metals after an aging treatment. A transition from ductile to brittle crack propagation of unirradiated PRTR Zircaloy-2 pressure tube specimens occurred at a temperature between 70 and 200°F. This transition temperature for irradiated specimens appeared to be above 200°F. At room temperature, the stress for propagating a 1 in. long crack was indicated to be 11,500 psi greater for a fast neutron exposure of 1.5×10^{21} nvt than for a fast neutron exposure of 2×10^{20} to 5×10^{20} nvt or than for unirradiated specimens. (W.L.G.)

34628 (HW-84384(p.5.1-6)) FUELS STUDIES. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Studies of fabrication and properties of UO_2, $BeO-PuO_2$, and PuO_2-UO_2 are described. Work is also described on EBWR Pu recycle fuel PRTR fuel element fabrication and testing, fabrication of Phoenix fuel, and metallic fuels development. (J.R.D.)

34629 (ORNL-3812(p.63-86)) METALLURGY. (Oak Ridge National Lab., Tenn.).

INOR-8 was found to be compatible with N_2 atmospheres containing 0.03 to 5.6% O_2 at 1300 and 1400°F. Alterations on the MSRE heat-exchanger tube bundle were completed in which four tubes were removed and the stub ends were plugged. The morphology of INOR-8 weld metal was studied, and a phase associated with weld cracking was found to contain more Al and Si than exists in the INOR-8 composition. Brazing studies were begun on combinations of materials expected to be useful for making graphite-to-INOR-8 joints. Oxygen contamination was found to meet specifications in the graphite core bar and lattice bar specimens. The O_2 concentration did not vary appreciably with the size of specimen or the section of bar from which it was obtained. A creep-test experiment was designed and built to study in-reactor creep of INOR-8 as part of an expanded program to study the effects of irradiation on the elevated-temperature properties of INOR-8. (J.R.D.)

34630 (TID-3583) BISMUTH, LEAD, AND TIN TELLURIDES. A Literature Search. Lanier, Sidney F., comp. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). May 1965. 56p. Dep.(mn); $3.00(cy), 1(mn) CFSTI

A total of 699 references are included to journal articles and reports dealing with chemical and physical properties of bismuth, lead, and tin tellurides. The references are arranged by subject. Author and report-number indexes are included. (auth)

34631 RECENT DEVELOPMENTS IN THE RADIOGRAPHY OF HIGHLY RADIOACTIVE SPECIMENS AT A.E.R.E., HARWELL. Parish, R. W.; Pullen, D. A. (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Brit. J. Non-Destructive Testing, 7: 3-10(Mar. 1965).

Techniques were developed which make possible the radiography of highly radioactive materials. Projection radiography is used in each of the two methods described, and no elaborate or expensive equipment is used other than a standard 200 kv, half wave, 4 ma, portable x-ray unit. In the first method, fogging of the radiograph caused by gamma radiation is counteracted, during processing, by the use of chemical, film density reducing agents. Color film is used in the second method. Successful radiographs have been produced of specimens emitting 1250 rads per hour of fission products at 1 ft. (auth)

34632 HIGHER PERFORMANCE FROM PWR CORES. Nucl. Eng., 10: 220-2(June 1965).

In pressurized water reactor cores, both stainless steel and Zircaloy have shown reliable performance. Results of extensive post-irradiation examinations are briefly summarized. Future progress in the development of Zircaloy cladding for PWR applications is considered. (J.F.P.)

34633 METALLURGY AND MATERIALS RESEARCH. p.55-73 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Results are presented concerning preparation of research materials; structure and properties of crystalline and non-crystalline substances; corrosion and oxidation; diffusion; crystal defects, deformation, and mechanical properties of metals; and radiation effects on materials. (T.F.H.)

34634 ENGINEERING PHYSICAL METALLURGY. Lakhtin, Y. Translated from the Russian by Nicholas Weinstein. Russian Monographs and Texts on Advanced Mathematics and Physics. New York, Gordon and Breach, 1965. 471p. $14.50.

This book treats the fundamentals of physical metallurgy and heat treatment of steel, cast iron, and nonferrous metals. The latest developments made in Soviet Union and other countries are elucidated. (D.L.C.)

34635 IMPROVEMENTS IN OR RELATING TO ZIRCONIUM-BASE ALLOYS. Evans, Evan William; Lees, Donald Grainger (to Imperial Metal Industries (Kynoch) Ltd.). British Patent 988,069. Apr. 7, 1965. Filed Sept. 26, 1962.

The proposed treatment of Zr-2½% Nb alloy is intended to improve corrosion resistance while maintaining good strength. The alloy is solution-treated at 800 to 860°C, cold-worked to a reduction between 10 and 50%, and aged

at 470 to 520°C. The alloy may be cold-worked prior to solution treating. The method is suitable for fabrication of tubes for use in water-cooled reactors. (A.G.W.)

34636 COMBUSTION CHAMBER LININGS. (to Brown, Boveri and Co. Ltd.). British Patent 989,996. Apr. 22, 1965. Priority date July 26, 1962, Switzerland.

A combustion chamber for a magnetohydrodynamic machine includes a support member having wall portions defining a passage for the flow of cooling fluid and lining elements consisting at least partially of ceramic material. The lining elements are supported by plugs secured to and extending away from the wall. Thermal stresses in the lining are reduced by the radiative cooling provided by this arrangement and by the fact that the lining elements are separate and free to expand in all directions. (A.G.W.)

34637 IMPROVEMENTS IN OR RELATING TO URANIUM ALLOYS. Gittus, John Henry; Slattery, Gerard (to United Kingdom Atomic Energy Authority). British Patent 990,121. Apr. 28, 1965. Filed Apr. 19, 1962.

A uranium-molybdenum-aluminum alloy that yields a fine grain structure on casting contains 0.5-3 at. % Mo and 0.5-1.5 at. % Al, the balance being U and incidental impurities. A procedure for casting the alloy into a form suitable for reactor fuel rods is suggested. (A.G.W.)

34638 REFRACTORY RARE EARTH MATERIAL. Kleber, Eugene V.; Vickery, Ronald C.; Muir, Hubert M. (to Nuclear Corp. of America). U. S. Patent 3,185,652. May 25, 1965. Filed Apr. 29, 1960.

A ductile refractory composition containing at least 3%, preferably 10%, of rare earth metals and rare earth oxides is reported. The term rare earth metal refers to the elements of atomic number 21, 39, and 57 through 71. The homogeneous melt may include one or more metals and one or more oxides with special properties being obtained by the use of certain elements or combinations thereof. The mixtures have very high melting points and may be employed in structural or control elements in combination with a source of intense heat or nuclear radiation, particularly as control elements and shields for reactors, for rocket nose cones, for furnace linings, and for rocket launch pads. (B.L.M.)

Corrosion

Refer also to abstracts 35619 and 35759.

34639 (BNWL-79(p.5.1-11)) CHEMICAL METALLURGY. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The rate of evaporation of Haynes Alloy 25 was essentially stopped at 1100°C by an overpressure of ~80 torr H_2. The oxidation of pure Nb at temperatures of 800, 900, and 1000°C in continuously replenished O_2 atmospheres of 1 to 6μ was studied. The Nb had a strong affinity for O_2 at low O_2 pressures and the initial reaction kinetics were controlled by the rate of O_2 transport. The oxidation rates of Hastelloy X, Haynes Alloy 25, and Nb-1 Zr exposed to high pressure, high velocity He at 2050°F were comparable to those obtained in static systems. The inhibition of gas phase hydriding of Zircaloy-2 by water vapor at low temperatures was not effective when the metal surface had been mechanically sensitized. Mild steel chain 80% black to neutrons was successfully produced by pack-boridizing the chain in Ferroboron for 9 hr at 1160°C or 12 hr at 1140°C. (W.L.G.)

34640 (CNLM-6246) CORROSION STUDIES OF REFRACTORY METAL ALLOYS IN BOILING POTASSIUM AND LIQUID NaK. Kelly, K. J.; Blecherman, S. S.; Hodel, J. E. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Aircraft Nuclear Engine Lab.). Apr. 22, 1965. Contract AT(30-1)-2789. 22p. (CONF-650434-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From AEC-NASA Liquid Metals Information Meeting, Oak Ridge, Tenn.

Compatibility evaluations were made in gravity-feed potassium loops at temperatures up to 2000°F on the following materials: Nb-1 Zr, PWC-533 (C-Mo-Nb-Ti-Zr), PWC-11 (C-Nb-Zr), Type 316 stainless steel, and Mo-TZM. The evaluations were based on weight changes, chemical analyses, metallographic examinations, and mechanical strengths. A study was also made of interactions of Nb-1 Zr specimens in a Type 316 stainless steel-eutectic NaK loop operated at 1250°F. (D.L.C.)

34641 (EURAEC-1223) IMPERFECTIONS IN METALS. II. CORROSION AND OXIDATION. Quarterly Report No. 7, April 1-June 30, 1964. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Contract 082-62-7 RDB. 18p. (EUR-2053; R-2314). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Oxide films formed on annealed titanium in air at atmospheric pressure for varying time intervals at 450 to 700°C, were investigated by transmission electron microscopy and diffraction. The oxide films were stripped off by dissolution of the substrate. The films consisted almost completely of the rutile modification of titanium dioxide. The general grain structure of the substrate metal was replicated by the oxide film. Preferential oxidation at the grain boundaries took place, resulting in a considerable grain-boundary thickening. Besides a heterogeneous behavior of the oxidation due to the rate dependence on the crystallographic orientation of the metal grains, a substructure was also observed within some of the individual grains. This island structure presented crystallographic orientations. The islands consisted of polycrystalline rutile whose appearance was strongly dependent on the time-temperature conditions for the oxidation. Pustules were also found but it is supposed that they do not represent an essential feature of the oxidation mechanism. (auth)

34642 (ORNL-3751) THE EFFECT OF OXYGEN ON THE CORROSION OF NIOBIUM BY LIQUID POTASSIUM (thesis). Litman, Arnold Powell (Oak Ridge National Lab., Tenn.). July 1965. Contract W-7405-eng-26. 118p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

Submitted to Univ. of Tennessee, Knoxville.

The behavior of niobium in liquid potassium at 200, 600, and 815°C was influenced by oxygen in the components and by temperature and time. The manifestations of corrosion were observed to include the production of surface and subsurface corrosion products and the mass transfer of oxygen, niobium, and potassium, all of which were enhanced by higher temperatures and longer times. Analysis of the surface scales indicated they were predominantly niobium dioxide, but that niobium metal, niobium oxide, potassium metaniobate, and unidentified species were sometimes present. The subsurface second phase was tentatively identified as niobium dioxide. The subsurface product was never observed when less than 1000 ppM oxygen were initially in the niobium. Higher initial oxygen concentrations in the niobium or the potassium resulted in more rapid thickening of the surface scales. Hardness profiles of the specimens as a function of time confirmed that a loss of oxygen from the niobium occurred by solid-state diffusion at 600 and 815°C but that no loss occurred at 200°C. The uptake of niobium by the potassium was increased by higher temperature and oxygen concentration in the potassium. The observations that oxygen migrated out of the niobium even when niobium dioxide was frequently found in the surface and subsurface scales and that niobium dioxide was found to be unstable in excess potassium have necessitated a proposal that the formation of one or more ternary compounds like $K_xNb_yO_z$ provide the driving force for system corrosion. It was hypothesized that these compounds are sufficiently stable thermodynamically to reduce the chemical potential of the oxygen in solution considerably below that which exists for equilibrium with binary oxides. Further, it was proposed that these species contain niobium in a lower valence state and that they react or disproportionate on cooling to yield the corrosion products observed at room temperature. (auth)

34643 FOR THE KNOWLEDGE OF THE PHYSICAL PROPERTIES OF LIQUID METALS. PART II. TEMPERATURE RANGE BETWEEN BOILING POINT AND ABOUT 1300°C. Spiller, K. H. (Euratom, Ispra, Italy). Atomkernenergie, 10: 215-27(May-June 1965). (In German)

For the liquid metals Na, K, and NaK alloys in the temperature range between boiling point and 1300°C data on density, specific heat, thermal conductivity, viscosity, surface tension, vapor pressure, and heat of vaporization are given. These also cover the vapor phase, when applicable. These figures were examined critically. Graphs of the most likely figures plotted against temperature were made as well as a Mollier diagram of Na. Data concerning corrosion are included. (auth)

34644 EFFECT OF SURFACE TREATMENT ON THE CORROSION OF STAINLESS STEELS IN HIGH-TEMPERATURE WATER AND STEAM. Warzee, M. (Societe d' Etudes, de Recherches et d'Applications pour l'Industrie, Brussels); Hennaut, J.; Maurice, M.; Sonnen, C.; Waty, J.; Berge, Ph. J. Electrochem. Soc., 112: 670-4(July 1965).

The corrosion behavior of AISI 304 and 410 steels as well as 23.5 Cr–21.5 Ni steels in superheated steam at temperatures between 400 and 600°C was found to be influenced markedly by preliminary surface treatments: electrolytic polishing, mechanical polishing, milling, lathe-turning, and grinding. The treatments accompanied by cold working reduced the corrosion rate and the effect was retained for long times (at least 2000 hr for AISI 304 steel at 450°C). This enhanced corrosion resistance was attributed to the presence of cold-worked surface layers, which were detected by measurement of x-ray line broadening. Electron microprobe analyses of the oxide layers and of the underlying metal showed that the oxide was enriched and the metal depleted in chromium and manganese. These elements thus seemed to diffuse through the cold-worked layer toward the oxide. In water, at 300°C and below, the phenomena were more complex. (auth)

34645 THE MIGRATION OF METAL AND OXYGEN DURING ANODIC FILM FORMATION. Davies, J. A.; Domeij, B.; Pringle, J. P. S.; Brown, F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Electrochem. Soc., 112: 675-80(July 1965).

Beta spectroscopy and radiotracer techniques were used to study the transport of metal and oxygen during anodic oxidation. Both species were mobile during oxide film growth on Al, Nb, Ta, and W, but in Zr and Hf only oxygen transport was observed. Radiotracer measurements showed that the amount of metal dissolving in the electrolyte was usually less than 1% of the total oxidized, but that for Al it could be as high as 40%, depending on the current density and electrolyte used. (auth)

34646 MOLYBDENUM OXIDATION KINETICS AT HIGH TEMPERATURES. Bartlett, R. W. (Philco Corp., Newport Beach, Calif.). J. Electrochem. Soc., 112: 744-6(July 1965).

Polycrystalline molybdenum rods, 0.125-in. initial diameter, were used as samples and heated electrically. The furnace chamber was maintained at the appropriate oxygen pressure by controlling the flow of dry oxygen through the system. Oxidation rates were determined by measuring the sample diameter at intervals using an optical technique. Temperatures were measured with either a color-ratio optical pyrometer or a disappearing filament pyrometer corrected for the emissivity of molybdenum. After ignition, the color temperature of the flame, measured by a color ratio optical pyrometer, varied from 2200 to 2500°C in 0.1 atm of oxygen and between 2700 and 2800°C in 1 atm of oxygen. The high flame temperature associated with an oxygen pressure of 1 atm caused the sample to melt within a few seconds after ignition of the flame. The primary surface oxidation reaction was formation of the molybdenum dioxide monomer $Mo + O_2 \rightarrow MoO_2(g)$. The net secondary reaction in the gas phase, including oxidation and polymerization to the dominant equilibrium species $(MoO_3)_3(g)$ is $\frac{3}{2}O_2 + 3MoO_2(2) \rightarrow (MoO_3)_3(g)$. (F.J.H.)

34647 THE FAILURE OF STRESSED ZIRCALOY IN AQUEOUS CHLORIDE SOLUTIONS. Thomas, K. C.; Allio, R. J. (Westinghouse Electric Corp., Pittsburgh). Nucl. Appl., 1: 252-8(June 1965).

The susceptibility of Zircaloy-4 and crystal-bar zirconium to failure in aqueous ferric chloride solutions was determined as a function of stress, hydrogen content of the metal, and chloride concentration of the solution. Intergranular failures were observed in all cases. Based on these results, a model for the failure of stressed zirconium-base alloys in chloride solutions is proposed, viz. that cracks initiated at the hydride phase near the surface by dislocation pileups can propagate under the action of a corrosive medium, resulting in eventual catastrophic failure. This model predicts a failure that is dependent on amount of hydride present, orientation of the hydride, and time. (auth)

34648 OXIDATION KINETICS OF TUNGSTEN AND NIOBIUM ALLOYS. Prokoshkin, D. A.; Vasil'eva, E. V.; Lazareva, I. Yu. pp 241-7 of Issledovaniya Metallov v Zhidkom i Tverdom Sostoyaniyakh. Moscow, Izdatel'stvo Nauka, 1964. (In Russian)

Oxidation kinetics of binary tungsten alloys with up to 50 wt % Nb were studied. Oxidation of alloys was carried out in the open air at 900, 1000, 1100, 1200, and 1300°C. No evidence was found to indicate a transition to parabolic type of oxidation in W–Nb alloys at temperatures below 1300°C. The highest resistance to oxidation was found in alloys with 30% Nb. (R.V.J.)

34649 CORROSION AND PROTECTION OF METALS. Lectures Delivered at the Institution of Metallurgists Refresher Course, April 1964. London, Iliffe Books Ltd., 1965. 106p. 27s 6d.

Four lectures are included: fundamental principles of corrosion, critical review of corrosion test methods, selection of materials for corrosion resistance, and control of corrosion in common environments. (D.L.C.)

Fabrication

34650 (AD-609686) PRODUCTION ENGINEERING MEASURE FOR BERYLLIUM OXIDE AND PARTS PRODUCED FROM IMPORTED ORES. Quarterly Progress Report No. 4, April 1–July 31, 1964. Blum, J. F.; Wambold, J. N. (Beryllium Corp., Reading, Pa.). Contract DA-36-039-AMC-01471. 38p. $2.00(CFSTI).

Development work has shown that powder varies throughout a large calcination bed. The tops are more sinterable and have a finer particle size distribution than do the bottoms. It was shown that a very uniform powder was obtained from batch to batch in large calcination beds when the total powder from each run was blended to obtain a composite powder for each run. Precompaction was evaluated as a method to increase powder bulk density for better fill and flow properties. The precompacted powder was far superior to the normal powder with respect to these characteristics. However, some preliminary data indicate that the dielectric strength of parts prepared from powder previously precompacted at high pressure (18,000 psi) may be adversely affected. Extrusion development has shown that water soluble starches can replace floc-gel starch as a binder. Some control problems were evaluated. (auth)

34651 (AD-612490) DEPARTMENT OF DEFENSE REFRACTORY METALS SHEET ROLLING PROGRAM. Status Report No. 3, June 1962–November 1, 1964. Maykuth, D. J. (Defense Metals Information Center, Battelle Memorial Inst., Columbus, Ohio). Jan. 26, 1965. Contract AF33(615)-1121. 43p. (DMIC-212) $2.00(CFSTI).

The status of the refractory sheet rolling program is summarized with specific consideration of molybdenum alloys, tungsten, niobium alloys, and tantalum alloys. (D.C.W.)

34652 (BMI-X-256) A STUDY TO IMPROVE THE REMNANT POLARIZATION OF PZT FERROELECTRIC CERAMICS. Summary Report. Hanes, H. D.; Bodine, E. G.; Hodge, E. S. (Battelle Memorial Inst., Columbus, Ohio). Sept. 13, 1963. Contract W-7405-eng-92. 31p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Gas-pressure bonding was studied as a means for producing dense $Pb(Zr_{0.65}Ti_{0.35})O_3$ with high remnant polarization. Mild steel lined with ZrO_2, SiO_2, TiO_2, and Pt, stainless steel lined with ZrO_2 and Pt, and Inconel lined with ZrO_2 and an aluminized coating were investigated as container materials. Densification temperatures were varied up to 1400°C. Also, specimen containers were evacuated, O_2 filled, and air filled. The best containers were ZrO_2- and Pt-lined stainless steel up to 1200°C. Capsule environment had no noticeable effect. Bonding temperature had little effect on grain growth above 1200°C; the maximum average grain diameter was 4 to 5 μ. Density appeared to increase up to 1200°C and then decrease. It was concluded that the density variation above 1200°C was caused by a change in composition. Maximum remnant polarization (44.4 μ coul/cm^2) was achieved by bonding at 1200°C. Specimens bonded at 1250 and 1300°C broke down electrically during testing. (auth)

34653 (GA-6399) FUEL FABRICATION TECHNIQUES FOR HIGH TEMPERATURE GAS-COOLED REACTOR FUELS. Ragone, D. V. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). May 7, 1965. Contract AT(04-3)-167. 18p. (CONF-650606-8) Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From EURATOM Symposium on Fuel Cycles of High-Temperature Gas-Cooled Reactors, Brussels.

The fuel for future General Atomic High Temperature Gas-Cooled Reactors will probably be in the form of fission-product-retaining, coated particles. These will be incorporated, either loose or bonded, into a graphite structure which will serve as the fuel element. The fabrication of these coated particles consists of two steps, the formation of the fuel-bearing seed and the deposition of the coating. Relative merits of "dry" processes and "wet" processes for seed production are discussed. "Dry" processes include agglomeration, followed by sintering or fusion of the agglomerate, and plasma arc processes. The sol gel process is used as an example of a "wet" technique. Of the techniques listed, the agglomeration-sinter or melt combination is the method by which most of the particles to date have been made, while the sol gel method holds the most promise for low cost fabrication. The seeds are coated by the application of pyrocarbon and/or silicon carbide by pyrolysis of appropriate compounds while the particles are suspended or agitated in some way. This can be done in a fluidized bed, a rotating drum device (similar to a ball mill) or in a vibrating bed. The fluidized bed technique is probably the most developed of the ones listed. Coatings having a great variety of physical and mechanical properties can be deposited by this method by varying the temperature of deposition, the gas flow rate and the coating gas composition. There are still a great number of uncertainties in the production processes which can only be resolved by production experience. (auth)

34654 (NMI-1263) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. DEVELOPMENT OF ZIRCONIUM-BASE ALLOYS STRENGTHENED BY SLIS TECHNIQUES. Summary Technical Report, July 1, 1963–June 30, 1964. A. R. Kaufmann and W. C. Muller (Nuclear Metals, West Concord, Mass.). Jan. 15, 1965. Contract AT(30-1)-2784. Dep.(mn); $3.00(cy) 2(mn) (CFSTI).

A program was carried out to develop zirconium-base alloys by the SLIS technique in which fine dispersions are achieved with metallic particles. Beryllium, which has a negligible solid solubility with zirconium and forms the compound Be_2Zr, was used as an alloying element with zirconium and Zircaloy 2. Two zirconium-base SLIS alloys were produced during the program. These were splat-cooled SLIS alloys of Zr–0.8 wt% Be and Zircaloy 2–0.68 wt% Be. These alloys were prepared by dissolving beryllium in liquid zirconium or Zircaloy 2 and then rapidly quenching. Examinations of both of the alloys as-quenched showed that a fine precipitate in the 0.06-μ-dia range had been produced. After consolidation of these splatcooled alloys by compaction and extrusion at 600°C precipitate particles had an average diameter of 0.1 to 0.14 μ at concentrations of about 12 to 30 × 10^{12}/cm^3. Subsequent aging of the Zr–Be and Zy2–Be SLIS alloys at 600°C for 100 hr resulted in a modest increase in the populace of the coarser particles thus resulting in lower particle densities. The results of the program demonstrate that it is possible to produce Zr–Be and Zircaloy 2–Be alloys having a fine dispersion of Be_2Zr by the splatcooling technique. Furthermore, the mechanical properties of these Zr–Be and Zy2–Be alloys are substantially better than that of unalloyed zirconium and Zircaloy 2. At room temperature the ultimate tensile strength of the splatcooled Zr–Be and Zy2–Be alloys is 122,500 and 134,600 psi, respectively. At a test temperature of 600°C the ultimate tensile strength of the Zr–Be splatcooled alloy is improved over that of unalloyed zirconium and Zircaloy 2 by nearly a factor of 2; similarly the Zy2–Be splatcooled alloy was improved by about a factor of 3. Although aging of these SLIS alloys at 600°C for 100 hr has had a noticeable effect upon the precipitate, it has had only a moderate effect upon the mechanical properties of these alloys. The limited corrosion studies conducted with the splatcooled Zircaloy 2–0.68 wt% Be SLIS alloy provide encouragement for further studies that would improve this SLIS alloy for use in a temperature range of 400 to 800°C. (auth)

34655 (NP-15134) EFFECT OF MULTIPLE WELD REPAIRS AND 400 F INTERPASS TEMPERATURE ON PIPING PERFORMANCE. Final Report. Meister, R. P.; Beall, L. G.; Conklin, D. E.; Hyler, W. S.; Martin, D. C. (Battelle Memorial Inst., Columbus, Ohio). Oct. 30, 1964. Contract N102-76878. 52p.

The effects of high weld interpass temperature and repair welding on the performance of butt-welded pipe joints were evaluated. The fatigue behavior of joints welded with high interpass temperature and joints containing repair welds were compared with control series welds made to the NAV SHIPS 250-692-2 specification. Girth butt welds were made in 4-inch-diameter, Schedule 40 carbon steel, copper–nickel, and Monel pipe using a consumable-insert joint design. After fusing the consumable insert by the manual tungsten-arc process, the major portion of the girth welds was deposited by the manual metal-arc process. The effect of four successive metal-arc weld repairs was evaluated in carbon-steel welds. The effect of 400-450°F weld interpass temperature was evaluated in Monel and copper–nickel welds in addition to the effect of the multiple weld repairs. The test welds were inspected by magnetic-particle or dye-penetrant and radiographic methods. The pipe specimens were fatigue tested as cantilever beams with a rotating load at the free end. The test weld was located about 5 inches from the fixed end. The pipes were pressurized internally with fresh water for the carbon steel and salt water for the copper–nickel and Monel pipe specimens. By rotating the load at the free end of the specimen, each area of the test weld throughout the circumference experienced the same tensile and compressive stresses. After fatigue test the specimens were carefully examined to determine the origin of the failure. Multiple weld repairs, either within the confines of the original girth butt welds or extending into the base metal to broaden the weld to 3 times its original width, did not significantly reduce the fatigue properties of carbon-steel joints. Either of the two types of multiple weld repairs caused degradation of fatigue properties of Monel and copper–nickel weld joints. The use of a 400-450°F weld interpass temperature did not lower the fatigue properties of Monel welds. The use of 400-450°F weld interpass temperature did lower the fatigue properties of copper–nickel welds. The fatigue life of joints welded with the consumable insert in the copper–nickel pipe was substantially greater than the fatigue life of weld joints made when using

the integral-backing-ring joint design evaluated during a previous program. (auth)

34656 (ORNL-P-1431) MATERIALS CONTROL IN THE FABRICATION OF ENRICHED URANIUM FUELS. Cardwell, Roy G., Jr. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 23p. (CONF-650802-2). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From IAEA Symposium on Nuclear Materials Management, Vienna.

Material control problems and their solutions during the fabrication of various types of enriched uranium fuel components, are discussed. The basic objectives of a good materials control system are outlined. Experience in the fabrication of various fuel elements at ORNL and the development of control procedures are described. (D.L.C.)

34657 (RFP-518) CERAMICS, RESEARCH AND DEVELOPMENT QUARTERLY PROGRESS REPORT FOR OCTOBER-DECEMBER 1961. Kessell, D. J. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). May 21, 1965. Contract AT(29-1)-1106. 23p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

Crucibles of AlN, TiC, TiN, ZrN, and Y_2O_3 were pressure-sintered in an induction heated graphite die. Reactions occurred between the die and TiN, ZrN, and Y_2O_3. The ZrN and Y_2O_3 crucibles were salvageable, but not the TiN. The design of a die assembly and the performance of several graphite susceptors for use in a new pressure-sintering unit are given. Progress in the isostatic-pressing of magnesia propellers and powder fabrication of small W crucibles is described. (W.L.G.)

34658 (SWRI-1228-64) EVALUATION OF THE SERVICEABILITY OF THE ELK RIVER REACTOR PRESSURE VESSEL. Progress Report No. 11, March 1-April 30, 1965. McDonald, Jose Jr.; Norris, Elwood B.; Speirs, Kenneth K. (Southwest Research Inst., San Antonio, Tex.). Contract AT(11-1)-1228. 21p. Dep. (mn); $1.00(cy), 1(mn) CFSTI

Low-cycle plastic fatigue properties of welds between dissimilar metals that simulate the ERR Pressure Vessel dissimilar welds were investigated. Mechanical-thermal cycling tests on welds that were stress relieved at 1100°F indicated that thermal cycling had no serious detrimental effect on the fatigue strength. The fatigue properties at 600°F of stress relieved specimens and specimens that were "buttered" with 309 weld metal prior to joining the stainless steel to the clad A105 carbon steel with 308 weld metal were quite similar. Specimens that were both "buttered" and stress relieved had a lower fatigue strength than the other groups. A macroscopic examination of all failures showed that the fatigue cracks initiated either in the stainless steel overlay or in the 308 weld metal. (W.L.G.)

34659 THE REMOTE FABRICATION OF REACTOR FUELS. Shuck, A. B.; Carson, N. J. Jr. Argonne Natl. Lab. Rev., 2: No. 3, 54-9(July 1965).

The advisability of remote refabrication of recycle fuels is indicated, and the equipment and techniques developed for the reprocessing and refabrication of fuel elements for the EBR-II are briefly described. (D.C.W.)

34660 VAPORIZATION BY ELECTRON BOMBARDMENT OF HIGH-MELTING METALS. Aubecq, M.; Brabers, M.; Henuset, M.; Meulemans, M. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Mem. Sci. Rev. Met., 62: 373-8(May 1965). (In French)

Studies were made of vaporization conditions for V, Nb, Cr, Si, and B. Degassing of the chamber and of the target metal and surface preparation of the part to be metallized are described. Types of electron guns used are discussed. The production of multiple films is reported. (auth)

34661 PRODUCTION OF HAFNIUM BY DIRECT REDUCTION OF ITS OXIDE IN THE ELECTRON BOMBARDMENT FURNACE. Gosse, G. (Departement Recherches et Developpements de la S. A. Heurtey, Paris); Albert, Ph.; Lehr, P. Mem. Sci. Rev. Met., 62: 407-13(May 1965). (In French)

Direct reduction of hafnium oxide in a vacuum, in the electron-bombardment furnace, using either aluminum or silicon was studied. With aluminum volatile sub-oxides (Al_2O or Al) were formed. In the case of silicon, the sub-oxide SiO was formed. Hafnium, which was malleable, could be obtained in this way. (auth)

34662 PROGRESS REPORT: FLASH WELDING COLUMBIUM AND TANTALUM. Reeder, Gordon W.; Lodwick, Ross American Welding and Mfg. Co., Warren, Ohio). Metal Progr., 88: No. 1, 115; 118; 120(July 1965).

The mechanical properties of the flash welded joints in Nb and Ta approached those of the parent metal. Because of the short welding cycle and small cross sections of the test specimens, inert gas shielding was not necessary. (W.L.G.)

34663 FABRICATION OF RADIOACTIVE SAMPLES FOR CROSS-SECTION MEASUREMENTS. Berreth, J. R. (Phillips Petroleum Co., Idaho Falls, Idaho). Nucl. Appl., 1: 230-4(June 1965).

For measurements of neutron cross sections as a function of energy by the fast-chopper technique, uniform samples are required. Intensely radioactive materials present difficult problems of sample fabrication. A method of fabricating such samples, applicable to a wide range of radioactive materials, consists of preparing the radioactive nuclide in the form of a finely divided chemically stable oxide, followed by mixing the oxide with aluminum powder and compacting into a solid bar. Special sealed containers for such samples provide tight containment of the radioactive material with a minimum of surface contamination. (auth)

34664 METHOD FOR VACUUM DEPOSITION OF COBALT METAL FILMS USING GRAPHITE CRUCIBLES. Rose, A. (Australian Atomic Energy Commission, Sydney). Nucl. Instr. Methods, 35: 165-6(1965).

A method for vacuum deposition of cobalt films is described in which carbon crucibles coated with zirconium metal and heated by electron bombardment are used. Films up to 2 mg/cm^2 thick have been prepared on backings of aluminum and graphite with a diameter and thickness of 0.5 and 0.005 in., respectively. (D.C.W.)

34665 THE PREPARATION OF OXIDE FILMS OF PROTACTINIUM, TANTALUM AND NIOBIUM ON PLATINUM. Brown, M. G.; Lyle, S. J.; Martin, G. R. (Univ. of Durham, Eng.). Nucl. Instr. Methods, 35: 353-4(Aug. 1965).

Niobium oxide and tantalum oxide films were prepared on platinum by electrodeposition of the elements from organic solutions, with subsequent ignition to remove organic matter and polishing. Films of niobium oxide and protactinium oxide were obtained by painting solutions containing the elements onto the platinum with the same subsequent treatment. (D.C.W.)

34666 PRIMENENIE PLAZMY DLYA POLUCHENIYA VYSOKO-TEMPERATURNYKH POKRYTII. (Applications of Plasma for Developing High-Temperature Coatings). Usov, L. I.; Borisenko, A. I. Moscow-Leningrad, Izdatel'stvo "Nauka," 1965. 85p.

A technical progress review is given of the techniques and methods for developing ionized gas and arc plasma. Descriptions are given of the methods and installations using plasma spray gun for coating with high-melting compounds. Data are included on the physical properties of coatings for protection of construction materials against high-temperature corrosion. (R.V.J.)

34667 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF NUCLEAR REACTOR FUEL ELEMENTS. Derek Green (to United Kingdom Atomic Energy Authority). British Patent 988,231. Apr. 7, 1965. Filed Dec. 29, 1960.

Two methods of compressing the sheath of a cylindrical fuel element into intimate contact with the fuel pellets inside it are proposed. In one method, localized radial compression is applied to the sheath through an elastically compressible ring that embraces the fuel element sheath and is compressed by pressurized hydraulic fluid applied

to the outside of the ring. In the second method, an elastically compressible sleeve fits over the fuel element sheath. End plugs closing the ends of the sleeve are braced apart so that application of pressurized hydraulic fluid to the outside of the sleeve causes radial but not longitudinal compression of the sheath. (A.G.W.)

34468 FORMATION OF CORROSION RESISTANT BERYLLIDE COATINGS ON METAL COMPOSITIONS. Cook, Newell Choice (to General Electric Co.). British Patent 989,806. Apr. 22, 1965. Filed Feb. 15, 1962.

The metals that may be beryllided by the method described are those having atomic numbers 21 to 29, 39 to 47, 57 to 79, and 89 to 98. Alloys of these metals with each other or alloys containing these metals as the major constituent can also be beryllided provided the melting point of the alloy is not lower than 600°C. An electric cell is formed, which contains the metal composition as one electrode joined through an external electrical circuit to a Be electrode and a fused salt electrolyte composed of BeF_2 and 10–66 ⅔ mole % of at least one alkali fluoride metal. The electrolyte is maintained at 600–900°C in the absence of oxygen. Beryllium ions diffuse into and react with the metal to form a tough adherent beryllide coating. (A.G.W.)

34469 IMPROVEMENTS IN OR RELATING TO PRESTRESSED CONCRETE VESSELS. Davidson, Ian (to United Kingdom Atomic Energy Authority). British Patent 989,663. Apr. 22, 1965. Filed Feb. 28, 1963.

A method of bracing a concrete vessel against bursting forces induced by internal pressure consists of embracing the vessel with one or more endless girdles formed by winding multiple turns of continuous solid wires or stranded cables about the periphery of the vessel. The girdle is tensioned by applying outward pull to straining members spaced at intervals around the vessel and then securing the girdle in the tensioned position. Apparatus for applying the girdles to the vessel is described. (A.G.W.)

34470 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. White, Douglas; Bell, Douglas Irving (to United Kingdom Atomic Energy Authority). British Patent 991,424. May 5, 1965. Filed May 30, 1962.

Sheathed fuel elements for nuclear reactors are manufactured by known methods except that deformation of the sheath into contact with the pellets is effected by high-energy shock wave treatment instead of by conventional fluid pressurization techniques. The high-energy shock waves may be produced by explosive means employing a liquid wave-transmitting medium, by electromagnetic means, or by electric discharge means. (A.G.W.)

34471 LONG LIFE URANIUM FUEL. Lillie, David W. (to General Electric Co.). Canadian Patent 707,262. Apr. 6, 1965.

This fuel consists of a mixture of a matrix material of depleted uranium and a dispersion of a second phase containing ^{235}U in amounts at least equal to that present in natural uranium. The powders can be sintered into a solid fuel. The material used to spike the matrix material may be either uranium enriched in ^{235}U, enriched UO_2, or a spiking powder with enrichment up to 90 to 95% ^{235}U. The preferred fuel is produced by combining matrix and spiking material to produce an average content of ^{235}U equal to the ^{235}U present in natural uranium. The advantage of this dispersion-type fuel is a decrease in radiation embrittlement and radiation swelling, because the fission fragments are virtually insulated from each other if the spiking particles are kept slightly more than 20 microns apart. (F.S.A.)

Properties and Structure

Refer also to abstract 35002.

34472 (BMI-X-10129) SODIUM TECHNOLOGY SUPPORT PROGRAM FOR PACIFIC NORTHWEST LABORATORIES, BATTELLE MEMORIAL INSTITUTE FFTF STUDIES, FY 1965. Simons, Eugene M.; Stang, John H.; Basham, Sam J.; Glaeser, William A.; Bell, J. Clarence (Battelle Memorial Inst., Columbus, Ohio). July 9, 1965. Contract W-7405-eng-92. 101p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

Information compiled on the possible basic materials of construction; materials for sodium-immersed components having mating surfaces in static or rubbing contact; and sodium-purity analysis and sodium-purity control requirements and techniques is presented. (W.L.G.)

34473 (BNWL-SA-177) EFFECT OF GEOMETRIC VARIABLES ON PERFORMANCE OF DOUBLE CANTILEVER BEAM SPECIMENS. Hoagland, R. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 4, 1965. Contract AT(45-1)-1830. 12p. (CONF-650522-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From Meeting of American Society for Testing Materials, Washington, D. C.

Tests were performed to determine the effect of changing the geometry of double cantilever beam samples (for plane strain fracture toughness data) on the compliance curves and on the fracture toughness values. The variables studied were gross thickness, beam depth, side groove depth, and side groove root radius. The material tested was 7075-T6 aluminum. (D.L.C.)

34474 (CEA-R-2735) ETUDE CRISTOLLOGRAPHIQUE ET EFFETS DE L'AUTOIRRADIATION SUR LE PLUTONIUM A BASSE TEMPERATURE. (Crystallographic Study and Self-Irradiation Effects on Plutonium at Low Temperature). Solente, Pierre (Commissariat à l'Énergie Atomique, Grenoble (France)). Centre d'Études Nucléaires). May 1965. 57p. Dep.(mn)

Thesis submitted to Université, Paris.

The variation of the lattice parameters of α-Pu and delta-stabilized Al–Pu alloys was measured at low temperatures to verify the existence of an antiferromagnetic transition. The effects of alpha particles on the length of polycrystalline α-Pu were studied at 4.2°K. No crystallographic changes from the structure of α-Pu at room temperature were noted at 18°K. The thermal expansion coefficients along the 3 axes appeared positive at 18°K, therefore, the magnetic contribution to the thermal expansion coefficient must be small. A dilatation anomaly and an anomaly of the diffraction line intensity were observed for δ-Pu at 100°K. No substructure lines were observed at 20°K. The length of α-Pu increased with time at a rate of 5×10^{-6}/hr when held in liquid He. This effect is attributed to the creation of Frenkel pairs. (W.L.G.)

34475 (EURAEC-1394) THE EFFECT OF RADIATION ON THE DUCTILE-BRITTLE TRANSITION IN PRESSURE VESSEL STEELS. Final Report, December 15, 1960–January 31, 1965. Anderson, E.; Bollmann, W.; Brandon, D. G.; King, D. L.; Malone, M.; Spreadborough, J. (Battelle Memorial Inst., Geneva (Switzerland)). May 1965. Contract 095-62-12 RDS. 52p. (EUR-2354). Dep.(mn); $3.00(cy), 1(mn) CFSTI

Work Performed under United States–Euratom Joint Research and Development Program.

A survey of the principal results obtained and the experimental methods and apparatus used during the past four years of the research program is presented. The principal results reported are the unirradiated properties of Armco iron and binary alloys of Armco iron with Cr, Mn, Ni, and Si. (W.L.G.)

34476 (EURAEC-1404) IMPERFECTIONS IN METALS. II. CORROSION AND OXIDATION. Quarterly Report No. 8, July 1–September 31, 1964. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Contract 082-62-7 RDB. 32p. (EUR-2363; R-2316). Dep.(mn); $2.00(cy), 1(mn) CFSTI

Work Performed under United States–Euratom Joint Research and Development Program.

Thermal oxidation films formed on annealed titanium foils were recrystallized in order to study the defect structure of the rutile modification of titanium dioxide. By this procedure large monocrystalline areas were ob-

tained suitable for transmission electron microscopy and diffraction. Several contrast effects were observed in these films. Extended fringe patterns, which sometimes formed closed loops, are attributed to antiphase boundaries. A model for the occurrence of this type of defect based on the idealized image of a hexagonal close-packed stacking of the oxygen ions in the rutile structure is proposed. This model is also reliable with the observation of twins with the (101) plane as boundary plane. The habit plane of the antiphase boundaries is an irrational plane for the tetragonal rutile lattice; it is however a simple plane in the oxygen lattice. The antiphase boundaries moved easily under enhanced electron irradiation. Mutual annihilation and disappearance of the boundaries was observed by annealing in the microscope. The model further explains the observation of antiphase boundaries ending at dislocations and the behavior at the contract between these boundaries and twin boundaries. Finally, geometrically shaped contrast features were observed which are attributed to cavities. (auth)

34677 (GA-6454) A RESEARCH PROGRAM ON THE EFFECT OF SUBSTRUCTURE ON THE IRRADIATION STABILITY OF ASTM A302 GRADE B STEEL. Quarterly Progress Report No. 1. Trozera, T. A.; Flynn, P. W. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). June 2, 1965. Contract AT(04-3)-167. 12p. (EURAEC-1410). Dep.(mn); $1.00(cy), 1(mn) CFSTI

Work Performed under United States–Euratom Joint Research and Development Program.

Samples from a 10-cm-thick plate of ASTM A302-B steel were taken in the three principal directions and tested in tension. The lower yield stress and ultimate tensile stress are ±1.5% in the three directions. A number of samples were also given various prestrain and heat treatments. A combination of 0.06 prestrain followed by a 475°C heat treatment for two hours had the following results: the lower yield stress was increased 22%; the ultimate tensile strength was increased 4%; and the uniform elongation was about the same as for samples tested in the quenched and tempered condition (as-received). (auth)

34678 (GEMP-362) EVALUATION OF CHROMIUM–RUTHENIUM ALLOYS. Wukusick, C. S. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). June 25, 1965. Contract AT(40-1)-2847. 23p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Cr–Ru alloys were prepared to investigate the effect of Ru on the ductility of Cr and to determine the optimum composition. The Cr–Ru alloys exhibited extensive twinning at low temperatures and low ductile-to-brittle transition temperatures in bending. Cracking at low temperatures was intergranular. Ru decreased the melting point of Cr, resulting in a low high temperature strength. Phase relationships and microstructures produced by aging at low temperatures gave support to a solute-segregation theory postulated to explain the improvement in ductility. (W.L.G.)

34679 (HW-84512RD) SPECIFICATION FOR NUCLEAR GRADE MIXED OXIDES (UO_2–PuO_2), HANFORD SALT CYCLE COMPACTIBLE POWDER. Anderson, H. J. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Nov. 16, 1964. Contract AT(45-1)-1350. 7p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The specification defines the physical and chemical characteristics required of high-density PuO_2–UO_2 particles. These particles were formed by the salt cycle process and are to be used in packed-particle fuel elements manufactured by a vibrational compaction or a similar process. Lot sizes, sampling, testing, test reports, and packing and marking are covered. (D.L.C.)

34680 (IS-T-13) THE ELECTRICAL RESISTIVITY OF THORIUM AND DILUTE THORIUM–GADOLINIUM ALLOYS (thesis). Page, David Fairfield (Ames Lab., Iowa State Univ. of Science and Tech.). May 1965. Contract W-7405-eng-82. 38p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

No resistivity minimum was observed for Th samples containing Gd in concentrations of 0.3 and 0.6 at. %. This is thought to indicate weak coupling between the localized magnetic moments of the Gd atoms and the Th conduction electrons. The relaxation time for scattering from magnetic impurities in Th, as calculated on the free electron model, is consistent with the idea that the energy gap in superconductors is reduced by magnetic impurity in proportion to the energy broadening from such scattering. The electrical resistivity of pure Th was found to vary as T^4 at low temperatures, and is not well described by the Bloch-Grüneisen relation at high temperature. Matthiesen's rule was obeyed for metallic impurities, but not for impurities such as C, N_2, and O_2. (auth)

34681 (LA-DC-6514) A CALCULATIONAL METHOD FOR THE DETERMINATION OF SURFACE TENSIONS FROM PHOTOGRAPHED MENISCI — WITH APPLICATION TO WATER AND MERCURY. Biery, J. C.; Oblak, J. M. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1960]. Contract W-7405-eng-36. 39p. Dep.(mn); $2.00 (cy), 1(mn) CFSTI.

A method was developed to calculate surface tensions from menisci in cylindrical tubes. A modified form of the Laplace-Young differential equation was numerically integrated to generate meniscus curves for assumed values of surface tension and tangent angle at the outer edge of the meniscus. The best values of surface tension and tangent angle were obtained by a minimization technique. This calculation method generated surface tensions of mercury and water within 0.5% of the published values. (auth)

34682 (LA-DC-6515) TABLES FOR THE DETERMINATION OF THE SURFACE TENSIONS OF LIQUID METALS BY THE PENDANT DROP METHOD. Bidwell, Richard M.; Duran, J. L. Jr.; Hubbard, Grant L. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1963]. Contract W-7405-eng-36. 11p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

Extended tables are presented for the reduction of measurements on drops, for the determination of surface tension by the pendant drop method. As they cover the range $0.20 \leq S \leq 1.10$, these new tables can be used for liquid metals as well as more conventional liquids, and probably cover all cases of practical interest. The significances of the various parameters used in the pendant drop method are clarified. (auth)

34683 (N64-26272) INTERPRETATION OF ROOM TEMPERATURE MECHANICAL PROPERTIES TEST DATA FOR PYROLYTIC GRAPHITE. Berry, J. M.; Gebhardt, J. J. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). May 1964. 35p. (R64SD39)

This investigation of the mechanical behavior of pyrolytic graphite had two objectives: (1) to develop an understanding of the phenomena of failure and apply it to the interpretation of mechanical properties data, and (2) to explore techniques for increasing room-temperature strength. Pyrolytic graphite is both exceedingly anisotropic and brittle. The conditions of deposition determine the degree of anisotropy, and this, in turn, has a marked effect on the relationships among specimen-test configuration, nominal strength, and fracture mode. Furthermore, the notch sensitivity is orientation dependent and, thus, related to the degree of anisotropy. The mechanical test results and studies of the fracture modes suggest that the results obtained by testing conventional laboratory specimens are not necessarily representative of those that would be obtained by testing free standing structures. (auth)

34684 (N64-272889) PROPERTIES OF NONSTOICHIOMETRIC METALLIC CARBIDES. Final Report. Norton, J. T.; Lewis, R. K. (Advanced Metals Research Corp., Somerville, Mass.). Apr. 6, 1964. Contract NASw-663. 42p. (NASA-CR-58046) $4.60(CFSTI).

A study of the carbides of the group IV transition metals (Ti, Zr, Hf) was made with primary emphasis on the Ti–C system. Specimens of high purity were prepared by powder metallurgy techniques over the nonstoichiometric range

$TiC_{0.50}$ to $TiC_{0.95}$. Specimens of sufficiently low oxygen content and low free carbon were obtained only in the range $TiC_{0.75}$ to $TiC_{0.92}$. The following properties which could be measured on powders or nondense specimens were determined as a function of carbon content: lattice parameter, specific gravity, thermal expansion, and thermoelectric power. The electronic structure of the nonstoichiometric carbides is discussed on the basis of the observed properties. (auth)

34685 (NIRL/R/93) SOME PRESSURE TESTS ON CIRCULAR AND RECTANGULAR DIAPHRAGMS OF POLYETHYLENE TEREPHTHALATE FILM. Middleton, A. J. (National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.). Mar. 1965. 21p. Dep.(mn); $0.70(BIS); 3s. 6d. (HMSO).

Bursting pressures and deflections of laminated membranes made from biaxially orientated polyethylene terephthalate film (Melinex and Mylar) were investigated for high energy and nuclear physics applications. Burst pressures of 1000 psi for a 5 inch port were achieved. Methods of clamping are discussed and effect of creep on life was estimated. (auth)

34686 (NMI-1266) FUNDAMENTALS OF SINGLE-CRYSTAL DEFORMATION IN ZONE-REFINED. BERYLLIUM. Final Report, July 1, 1961–June 30, 1965. Kaufman, D. F.; Pickett, J. J.; Aronin, L. R. (Nuclear Metals, West Concord, Mass.). June 30, 1965. Contract AT (30-1)-2784. 111p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

The effect of zone-refining on the purity and fundamental deformation behavior of Be single crystals was investigated. Zone-refining significantly reduces the impurity content of Be. The ultimate purity attainable is strongly dependent on the purity of the starting material. The highest purity attained, as indicated by mass spectrographic analysis and resistance ratio measurement, was realized by subjecting double distilled Be to six zone-refining passes. The principal benefits to deformation behavior derived from zone-refining are noted in flow and fracture behavior. Brittleness in single prismatic slip is eliminated. Large increases in basal glide capacity are realized. While fracture by basal cleavage is not eliminated at room temperature, it is not seen in the temperature range upwards of 425°C. These improvements are realized after a few passes on even the lower purity starting materials, and are attributable to the efficient removal of compounds such as BeO and second phase forming elements such as Al, Si, Mn, and Cr. Purification lowers the critical resolved shear stresses (CRSS's) for prismatic and basal slip, with that for basal slip showing a proportionately larger decrease. The prismatic CRSS is lowered from 10,000 psi to about 8000 psi and the basal CRSS from 2000 psi to about 200 psi in the purity range from commercial ($R_{298}/R_{4.2} = 2.5$) to six-pass double distilled ($R_{298}/R_{4.2} = 3300$). The anisotropy ratio, CRSS $(10\bar{1}0)$/CRSS (0001), is thus seen to increase from 5/1 in commercial purity to about 40/1 in highly purified material. The relatively high prismatic CRSS appears to be inherent. Up to 225°C in the same purity range, c-axis compression testing did not reveal any new deformation mode with a non-basal slip direction to permit relief of plastic anisotropy. Realloying with solid solution elements such as Fe and Ni restrengthens the basal plane and reduces the anisotropy ratio back to a lower level, while retaining the enhanced basal glide capacity of zone-refined material. There is evidence that realloying with combinations of impurities such as (Fe + Si + Al) impairs ductility by precipitate formation. (auth)

34687 (ORNL-P-1266) HYDRIDE AND BASAL POLE FIGURES IN ZIRCALOY-2 BY QUANTITATIVE METALLOGRAPHY. Picklesimer, M. L.; Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 26p. (CONF-650414-13) Dep.(mn); $2.00 (cy), 1(mn) CFSTI.

From 19th Metallographic Group Meeting, Oak Ridge, Tenn.

A technique was developed for rapidly determining by quantitative metallography the pole figure of hydride plates in Zircaloy-2 and the basal pole figure of close-packed-hexagonal metals. Approximately 200 trace angles are measured on each of three orthogonal surfaces, and smoothed histograms of the data are plotted. A trial-and-error approximation is made using these data to determine the pole figure. An eyepiece goniometer equipped with electrical read-out is used to measure and record the angle between specific reference directions and the traces of the hydride plates on the specimen surfaces. A polarized light metallurgical microscope equipped with a sensitive tint plate and electrical read-out of stage angle is used for locating and recording the basal plane trace in close-packed-hexagonal metals. The trace angle data in both determinations are collected on an x-y recorder with a remote pen action at a rate of 500 to 800 points per hour. Normally, the pole figure can be determined with sufficient accuracy in less than two hours on metallographically prepared specimens. The techniques will permit an easier quantitative study of preferred orientation in close-packed-hexagonal metals and determination of the interrelationships between stress axis, crystallographic preferred orientation, and stress orientation of precipitated hydrides in Zircaloy-2. (auth)

34688 (SWRI-1228-61) STUDIES OF THE FATIGUE STRENGTH OF PRESSURE VESSELS. (1) CYCLIC PRESSURE TESTS OF LARGE SIZE PRESSURE VESSELS. (2) LOW CYCLE FATIGUE TESTING OF ONE-HALF SCALE MODEL PRESSURE VESSELS. (3) EFFECT OF WELD DEFECTS ON THE FATIGUE STRENGTH OF A302B STEEL. Progress Report No. 14. Pickett, A. G.; Wylie, R. D.; Grigory, S. C.; Whiting, A. R. (Southwest Research Inst., San Antonio, Tex.). May 18, 1965. Contract AT(11-1)-1228. 47p. (SWRI-1228-62; SWRI-1228-63) Dep.(mn); $2.00(cy), 1(mn) CFSTI

A large size pressure vessel, constructed from T-1 steel, was deliberately fractured by overpressurization. The examination of the vessel and the in-process inspections made to either detect flaws or monitor their growth are described. The terminal failure was not investigated, however, each location where fatigue cracking was encountered was examined after terminal failure occurred. (W.L.G.)

34689 (TID-20986) LOW TEMPERATURE SPECIFIC HEATS OF AgSn ALLOYS. Green, Ben A. Jr.; Culbert, Harvey V. (Western Reserve Univ., Cleveland, Ohio). [1964]. Contract AT(11-1)-1108. 18p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The specific heats of pure Ag and Ag–Sn alloys up to 8 at.% Sn were measured between 2 and 4°K with a precision generally better than 0.5%. For pure Ag, the result is $\gamma = (0.646 \pm 0.005)$ mJ mole^{-1}°K^{-2} and the Debye temperature is (225.5 ± 0.5)°K, both in good agreement with one group of previous workers. The electronic coefficient γ varies linearly vs electron-per-atom ratio e/a at the rate $d(\ln\gamma)/d(e/a) = 0.22 \pm 0.06$, in agreement with Ag–Cd data. It is suggested that the available data on Cu–Zn and Cu–Ge are also consistent with this slope. The Debye temperature decreases on alloying, following a common curve vs e/a with the Ag–Cd results. The calorimetric method was unusual; repeated measurements were made at 2, 3, and 4°K only, and considerable thermal conductance was allowed between the sample and a cold reservoir. (auth)

34690 (UCRL-6826(Rev.I)) COMPRESSIVE CREEP OF CERAMICS FOR HIGH-TEMPERATURE NUCLEAR REACTORS. Vandervoort, Richard R.; Barmore, Willis L. (Lawrence Radiation Lab., Univ. of California, Livermore). Aug. 1964. Contract W-7405-eng-48. 22p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Beryllium oxide–uranium oxide mixtures were deformed in compression in the temperature region of 1375 to 1540°C. The apparent activation energy for creep is 95.1 kcal per mole. The creep rate dependence on stress and grain size is consistent with the Nabarro-Herring model. Creep behavior of the oxide mixtures for additions up to 10 wt % urania is ascribed to the deformation of the beryllium oxide matrix. (auth)

34691 (UCRL-11508) CALCULATIONS OF SURFACE POTENTIAL FOR OXIDE-PASSIVATED HIGH-RESISTIVITY SILICON. Deshpande, R. Y. (Lawrence Radiation Lab., Univ. of California, Berkeley). June 22, 1964. Contract W-7405-eng-48. 9p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

The fact that the oxide-passivated surface of high resistivity silicon is characterized by a high density of donor states is taken into account in calculation of the surface potential. (auth)

34692 (UCRL-13147(Pt.2)) THERMAL STRESSES DURING RAPID TRANSIENT HEATING. FINAL REPORT. PART 2. THERMAL STRAINS IN TUBES DURING TRANSIENT HEATING TO 2000 DEG F. Frisch, J.; Giedt, W. H. (California Univ., Berkeley. Inst. of Engineering Research). Feb. 1965. Contract W-7405-eng-48. 46p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The application of reluctance type displacement transducers for the measurement of high temperature strain was investigated. A prototype model was developed for measuring the radial strain of cylindrical thin-walled tubes subjected to transient internal convective heating from a plasma stream. It consisted of two diametrically opposed probes with ceramic tips which were spring-loaded against the test model. Radial movement of these probes was measured with two calibrated reluctance type sensors. Tests were conducted using Type 304 stainless steel, tantalum, and molybdenum cylinders. Average wall temperature increase rates were on the order of 300°F per second. Under these conditions the instantaneous temperature variation through the cylinder walls was found to be negligible. Strain measurements were made up to temperatures above 2,500°F. Excellent agreement between these measurements and calculated results was found up to 2,000°F. (auth)

34693 LIMITS OF HIGH-TEMPERATURE RESISTANCE OF NUCLEAR FUEL ELEMENTS. Hoeppner, G. (Kernforschungszentrum, Karlsruhe, Ger.). Atomkernenergie, 10: 163-8(May-June 1965). (In German)

The limit generally used to determine the thermal load capacity of cylindrical, slab-type, and spherical nuclear fuel elements is the melting temperature of the fuel in the center of the element. The parameters influencing the temperature distribution are discussed, i.e., the thermal conductivity of the fuel and the contact conductance between fuel and can. Cylindrical fuel elements can reach only relatively low surface loads and power densities, but they raise problems with respect to stability and cooling. The proposed spherical elements permit high surface loads, heat flux densities, power densities, and extremely high surface temperatures because of the fuel layer forming the outer surface of the sphere before cladding. (auth)

34694 FRICTION TESTS ON NUCLEAR-QUALITY GRAPHITE. Moulin, M. Bull. Inform. Sci. Tech. (Paris), No. 90, 33-49(Feb. 1965). (In French)

The production of graphite moderators for power reactors presents many problems including the rubbing of the various elements in the pile as a result of neutronic (Wigner effect) or thermal factors. Problems of friction at the nuclear graphite interface and on the steel-graphite interface were studied. The changes in the coefficient of friction of nuclear graphite rubbing against itself or against steel are of great importance, particularly in the case of alternative movement. The initial state of the surface has a very great influence on the value of the static friction coefficient. However, the coefficient varies with the number of cycles, and adhesion and transfer phenomena become predominant for moderate unit loads (2 kg/cm^2). In these conditions the friction coefficient varies between the extreme values of 0.14 and 0.50. Fine surface states are unfavourable since they give rise very rapidly to adhesion and to transfer phenomena, which result in high values of the static friction coefficient. (auth)

34695 MACLES AND STACKING FAULTS IN TUNGSTEN MONOCARBIDE. Corteville, Jacques; Pons, Louis (Institut Francais du Petrole, Rueil-Malmaison, France). Compt. Rend., 260: 4477-80(Apr. 26, 1965). (In French)

It is shown that the crystals of tungsten monocarbide WC can have macles of recrystallization or stacking faults under certain fritting conditions. The orientation of the macle is deduced from that of the associated crystal by rotation of 60° around the macle axis [0001] which thus becomes the symmetry axis of the sixth order. The stacking faults can be considered as the juxtaposition of two elementary macles of the preceding type. (tr-auth)

34696 X-RAY STUDY OF ZIRCONIUM AND HAFNIUM DIOXIDES AT TEMPERATURES UP TO 2750°C. Boganov, A. G.; Rudenko, V. S.; Makarov, L. P. (Grebenshchikov Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 160: 1065-8(Feb. 11, 1965). (In Russian)

The lattice parameters of ZrO_2 and HfO_2, which are potentially useful refractory materials, were examined by means of an x-ray diffraction camera in order to clarify the problem of polymorphic transformation taking place at high temperatures. The samples were heated to 2000°C by means of a tungsten heating element and to higher temperatures using an electron gun, thereby minimizing contamination by evaporation of the wall. On heating the anhydrous ZrO_2, which contained not more than 0.2% impurities, a reversible polymorphic monoclinic ⇌ tetragonal transformation was observed within the 1100 to 1200°C range; further heating to 2300°C revealed a second, tetragonal ⇌ cubic transformation. The x-ray diffraction study indicated that the high-temperature, cubic modification of ZrO_2 possesses a fluorite type lattice with a parameter a = 5.256 ± 0.003 Å at 2330°C. The temperature hysteresis of this completely reversible transformation did not exceed 20 to 30°C. It was concluded that when ZrO_2 is heated to a temperature close to 2400°C in vacuum, the stoichiometric lattice is not markedly affected. HfO_2 exhibited a reversible polymorphic monoclinic ⇌ tetragonal transformation between 1900 and 2000°C; the second transformation took place at about 2700 to 2750°C, close to the melting point of the oxide. This tetragonal ⇌ cubic transformation was also reversible. The lattice parameter of the cubic modification at 2750°C was about 5.300 ± 0.010 Å. (TTT)

34697 ON THE PRODUCTS OF SOLID-PHASE REACTIONS IN THE U_3O_8–Nb_2O_5 SYSTEM. Komkov, A. I.; Belopol'skii, M. P. (All-Union Scientific Research Inst. of Geology, USSR). Dokl. Akad. Nauk SSSR, 160: 1172-4 (Feb. 11, 1965). (In Russian)

Oxygen-containing U–Nb compounds were examined in order to clarify the phase composition of sintered metamict minerals of this system. Sintering of the oxide mixture with a U/Nb ratio of 1/3 at 830 to 850°C yielded a crystalline phase designated as α; all other mixtures yielded 2 phases: $\alpha + U_3O_8$ for U/Nb > 1/3 and $\alpha + Nb_2O_5$ for U/Nb < 1/3. At 1000 to 1050°C the α phase reacted with U_3O_8. In mixtures with U/Nb = 1 the β phase was formed and in those with U/Nb = 6 the γ phase was formed. Further transformations occurred on calcination at 1200°C. In mixtures in which U/Nb ≠ 1/3, 1, or 6, no new phases appeared but the lattice constants and the quantitative relations between phases were changed. For mixtures with 2 < U/Nb < 6, the sintering caused the disappearance of the β phase and the formation of a single γ phase with changed lattice parameters. For the 1.25 < U/Nb < 2 case, sintering at 1200°C resulted in the disappearance of the γ phase and the appearance of a single β phase, again with enlarged lattice parameters. The sintering process also changed the U^{6+}/U^{4+} ratio characterizing U_3O_8; in mixtures of U/Nb = 1/3, the U^{6+} increased and the U^{4+} content decreased. (TTT)

34698 THE ANISOTROPY OF GRAPHITE. Ubbelohde, A. R. (Imperial Coll., London). Endeavour, 24: 63-8 (May 1965).

The preparation and properties of what are effectively large single crystals of graphite are described. The anisotropy of the graphite single crystals and some uses for this anisotropic material are discussed. Some physical aspects of crystal anisotropy, the structure of graphite in relation to the synthesis of well-oriented material, bulk production of well-oriented graphite, and anisotropy ratios

of graphite are discussed. An all-graphite thermocouple using the anisotropic thermo-emf is described. (M.C.G.)

34699 DETERMINATION OF CONVECTION COEFFICIENTS OF SODIUM–POTASSIUM ALLOYS IN CIRCULAR TUBES. Skupinski, E.; Tortel, J.; Vautrey, L. (Commissariat a l'Energie Atomique, Paris and Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Intern. J. Heat Mass Transfer, 8: 937-51(June 1965). (In French)

Convection heat-transfer coefficients were determined in a horizontal circular tube, by means of temperature measurements in the duct, with NaK (44% Na to 56% K) in the steady state, both hydrodynamically and thermally, at a constant heat flux (q/A_{max} = 16 W/cm^2), at Reynolds numbers between 3.6×10^3 and 9.05×10^5 and Péclet numbers between 58 and 1.31×10^4. The Prandtl number was essentially constant around a mean value of 0.0153. The concentration of oxygen was of the order of 6 ppm. The experimental results were in good agreement with some previously published data and were well correlated by the relation $Nu = 4.82 + 0.0185\ Pe^{0.827}$. To verify that the experimental equipment was functioning properly, trial runs were first made with water. (auth)

34700 ABSORPTION OF BETATRON BREMSSTRAHLUNG BY THICK ALKALI-HALIDE SALT CRYSTALS. Vorob'ev, V. A.; Rudenko, V. N. (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 2, 174-5(1965). (In Russian)

For studying the absorption of betatron bremsstrahlung (30 Mev), a narrow beam was formed with a 20-mm-dia lead collimator. The beam intensity was continuously controlled by passage through an ionization chamber with a 20-mm-dia sensitive volume. The crystal dimensions were 30 by 30 mm^2, and its absorbing layer was 1 to 700 mm thick. A plot of the receiver ionization current, resulting from the secondary electrons released from the crystal, vs thickness showed that the highest values of the current are obtained with potassium, then potassium bromide, and potassium chloride. The values for passage of electrons varied conversely. The mass coefficients of attenuation of 30-Mev (for the initial part of the curve) betatron bremsstrahlung were 0.027, 0.029, and 0.032 cm^2/g gor potassium chloride, potassium bromide, and potassium iodide crystals, respectively. Decreasing the maximum quantum energy to 10 Mev did not change these values significantly. (TTT)

34701 MECHANISM OF DECOMPOSITION OF THE CUBIC SOLID SOLUTIONS IN THE SYSTEM ZrO_2–MgO. Viechnicki, D.; Stubican, V. S. (Pennsylvania State Univ., University Park). J. Am. Ceram. Soc., 48: 292-7(June 21, 1965).

The phase diagram for the system ZrO_2–MgO was reinvestigated by using coprecipitated gels. The thermal stability of the defective cubic solid solutions was investigated by a study of kinetics. The decomposition curves were sigmoidal, indicating that the formation of the tetragonal solid solutions proceeded by a process of nucleation and growth. Decomposition comprised: formation of the nuclei of the tetragonal solid solution on the grain surface, growth of the nuclei leading to the formation of an interface, and the irregular growth of that interface into the interior of the grain. During the decomposition magnesium ions diffused out of the regions of the growth of the tetragonal phase and partly precipitated as magnesium oxide at the grain boundaries. The decomposition rate increased with the degree of ordering or clustering of defects and impurities and with the number of the anion defects; it showed a maximum at about 1200°C. (auth)

34702 THERMAL CONDUCTIVITY OF URANIUM DIOXIDE FROM −57° TO 1100°C BY A RADIAL HEAT FLOW TECHNIQUE. Godfrey, T. G.; Fulkerson, W.; Kollie, T. G.; Moore, J. P.; McElroy, D. L. (Oak Ridge National Lab., Tenn.). J. Am. Ceram. Soc., 48: 297-305 (June 21, 1965). (ORNL-P-112)

A radial heat flow technique was used to measure the thermal conductivity, k, of polycrystalline UO_2 in the range from −57 to 1100°C. The technique yielded results with a probable accuracy of ±1.5% and a precision of ±0.1% in the range from 50 to 1100°C. Meaningful measurements were limited to 1100°C by Pt–90Pt10Rh thermocouple instability, although the apparatus was structurally sound to 1400°C. The thermal conductivity data up to 1000°C could be explained on the basis of heat transport by phonons. The thermal resistance, 1/k, exhibited a linear temperature dependence from 200 to 1000°C, which was expected for an insulator well above the Debye temperature. The slope of the 1/k-temperature plot was 0.0223 cm w^{-1}, which was independent of impurity content and associated with three phonon umklapp processes. The intercept was sensitive to impurity content as indicated by the fact that it was decreased by a decrease in the oxygen/uranium ratio. Between 1000 and 1100°C, there was a slight departure of 1/k from linearity which may be due to the onset of an electronic contribution. Near room temperature, UO_2 had a maximum in k, which was apparently caused by the rapid decrease in specific heat below this temperature. (auth)

34703 THE $\alpha \rightarrow \beta$ TRANSFORMATION IN ELECTROREFINED PLUTONIUM. Faiers, M. E.; White, J. S. (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Inst. Metals, 93: 405(July 1965).

Electrorefined plutonium was used to study $\alpha \rightarrow \beta$ phase transformations. Wire specimens were prepared and the difference of ~50 μohm-cm between the resistivities of the α and β phases, provided a sensitive method for following the $\alpha \rightleftharpoons$ transformations. A TTT curve was plotted and compared with the data of Nelson. Reasons for disparity between the two sets of data are discussed. (M.C.G.)

34704 ON THE EXISTENCE OF THE DIRECT $\alpha \rightleftharpoons \gamma$ TRANSFORMATION IN URANIUM DISPERSED IN AN INERT MEDIUM. Besson, J.; Blum, P. L.; Laugier, J. (Centre d'Etudes Nucleaires, Grenoble, France). J. Nucl. Mater., 16: 74-5(May 1965). (In French)

The variation of crystalline parameters of uranium was studied in the region of metastability. The uranium was intimately mixed with a finely powdered BeO to 66% U by weight. The evolution of the parameters of the α and γ phases were followed as a function of temperature. The $\alpha \rightleftharpoons \gamma$ transition occurred at 730 ± 5°C. The curves obtained showed no change of shape in the metastable region. The calculated values of the variations of enthalpy as a function of temperature agreed with experimental values. The mechanism for the direct $\alpha \rightleftharpoons \gamma$ transformation is discussed. (J.S.R.)

34705 MAGNETIC PROPERTIES OF GADOLINIUM AT HIGH PRESSURES AND HIGH TEMPERATURES. Belov, K. P.; Ergin, Yu. V.; Katsnel'son, A. A.; Ped'ko, A. V. (Moscow State Univ.). JETP Letters (USSR) (English Transl.), 1: 43-7(Apr. 15, 1965).

The saturation magnetization, the Curie point, and the temperature-dependence of the magnetic susceptibility of rhombohedral gadolinium was measured to clarify the question of the strong change in the magnetic saturation. It was found that gadolinium of rhombohedral modification has a lower effective magnetic moment than the gadolinium with hexagonal structure. (J.F.P.)

34706 RECRYSTALLIZATION OF BERYLLIUM. Moriceau, J.; Logerot, J. M.; Croutzeilles, M. (Centre de Recherches Metallurgiques, Chambery, France). Mem. Sci. Rev. Met., 62: 363-72(May 1965). (In French)

The recrystallization of beryllium sheet work-hardened by rolling at room temperature was studied. The sheet was produced from either cast or sintered, and subsequently hot-forged ingots. The effects of total impurity concentration and of BeO distribution were determined. The purest beryllium recrystallized at 700°C. The presence of a significant proportion of impurities increased the recrystallization temperature by 60°C and inhibited appreciably the grain boundary migration. (auth)

34707 USE OF NUCLEAR AND ELECTRONIC RESONANCE SCATTERING IN CRYSTALLOGRAPHY. Black, P. J. (Univ. of Birmingham, Eng.). Nature, 206: 1223-6 (June 19, 1965).

A method is described by which nuclear resonance effects could be used to achieve a considerable simplification in the problem of structure determination. It is also shown that the same method can be applied for electronic resonances and that it is an extension of methods already developed and used with these resonances. The nuclear and electronic techniques were compared in order to determine which is more likely to be useful in practice. (P.C.H.)

34708 PHASE STUDIES WITHIN THE SYSTEM ZrO_2–MgO. Viechnicki, D.; Stubican, V. S. (Pennsylvania State Univ., University Park). Nature, 206: 1251-2(June 19, 1965).

The limits of the cubic solid solution field in the ZrO_2–MgO system were determined. The following temperatures for the tetragonal to cubic phase inversion were found: 98 mole % ZrO_2 + 2 mole % MgO 2,343 ± 2°C, 94.5 mole % ZrO_2 + 5.5 mole % MgO 2,280 ± 90°C. The phase boundary between the field of the cubic solid solution and the field of the cubic solid solution plus MgO is at 26 mole % MgO at 1,750°C as determined by the precise measurements of the unit cell dimensions of the cubic solid solutions. (P.C.H.)

34709 NEUTRON MICRORADIOGRAPHY OF A CADMIUM–TIN ALLOY. Eppelsheimer, D. S.; Arment, Maynard (Univ. of Missouri, Rolla). Nature, 206: 69-70(July 3, 1965).

The feasibility of using neutron microradiography to investigate the internal structure of various alloys was tested on a Cd–Sn alloy. The method used was an adaptation of Beck's procedure. In this process the sample is placed on an indium sheet and irradiated by a monoenergetic, unidirectional flow of neutrons. After irradiation the indium is removed and placed against a photographic emulsion. Examples of the photomicrographs and neutron microradiographs are given. (M.C.G.)

34710 CONDUCTION IN TANTALUM-DOPED THORIUM DIOXIDE. Gammage, R. B.; Young, D. A. (Imperial Coll. of Science and Tech., London). Nature, 206: 74-5(July 3, 1965).

A study was made of the electric conductivity of hot-pressed thorium dioxide doped with various amounts of tantalum pentoxide. Oxidized material showed no useful decrease in resistivity. However, in the reduced condition the room-temperature resistivity of the doped samples was found to have fallen by 6 to 10 orders of magnitude with respect to pure ThO_2. Representative values measured in argon were 3 to 15 ohm cm (5 mole % Ta_2O_5) and 3,000 ohm cm (0.25 mole % Ta_2O_5). (M.C.G.)

34711 EQUIATOMIC TRANSITION METAL ALLOYS OF MANGANESE. IV. A NEUTRON DIFFRACTION STUDY OF MAGNETIC ORDERING IN THE PtMn PHASE. Andresen, A. F. (Institutt for Atomenergi, Kjeller, Norway); Kjekshus, A.; Moellerud, R.; Pearson, W. B. Phil. Mag. (8), 11: 1245-56(June 1965).

From x-ray and neutron diffraction and magnetic susceptibility measurements, the PtMn phase with the CuAuI type structure is found to exhibit anti-ferromagnetic arrangement of the magnetic moments with spin quantum number ½ for the Mn atoms and 0 for the Pt atoms. The moments of nearest-neighbor Mn atoms in (001) planes are anti-parallel to each other, and the direction of the moments changes from parallel to c in alloys with 50 at. % Pt and less, to perpendicular to c with more than 50 at. % Pt. Néel temperatures are observed in the range from 840 to 970°K. At lower temperatures the alloys show weak ferromagnetism which is believed to result from canting of the moments. (auth)

34712 THE DIFFUSION OF ^{95}Nb AND ^{182}Ta IN TANTALUM. Pawel, R. E.; Lundy, T. S. (Oak Ridge National Lab., Tenn.). Phys. Chem. Solids, 26: 937-42 (June 1965). (ORNL-P-915)

Diffusion constants were obtained for ^{95}Nb and ^{182}Ta in tantalum over the temperature range from 920 to 2500°C making use of lathe, grinding, and anodic film sectioning techniques. Over this temperature range, the lattice diffusion coefficients were observed to vary from about 2.5×10^{-18} to about 4×10^{-9} cm_2/sec for ^{95}Nb in tantalum. The ^{182}Ta diffusion coefficients were about half those for ^{95}Nb at all temperatures. The apparent variation in the activation energy for ^{95}Nb diffusion in tantalum was about 6000 cal/mole over the whole temperature range; thus the Arrhenius relationship was seen to apply exceptionally well to this system. The expression $D = 0.23 \exp(-98{,}700/RT)$ cm^2/sec describes the data within 20%. (auth)

34713 THE PHASE DIAGRAMS OF PRASEODYMIUM, EUROPIUM, GADOLINIUM AND YTTERBIUM. Stephens, D. R. (Univ. of California, Livermore). Phys. Chem. Solids, 26: 943-8(June 1965). (UCRL–12066)

The high-pressure, high-temperature phase diagrams of praseodymium, europium, gadolinium, and ytterbium were measured to 46 kbars. The melting curves of praseodymium and europium showed maxima. The hexagonal-bcc-liquid triple point for praseodymium was found to be at 940°C and 43 kbars. The impurity, stabilized hcp phase in ytterbium was present even in the 99.86-wt % pure material used in this work, and the fcc-hcp-bcc triple point was found to be at 475°C and 15.5 kbars. (auth)

34714 HEAT-CAPACITY BEHAVIOR OF IMPURE NEPTUNIUM METAL BELOW 320 deg K. Sandenaw, Thomas A. (Los Alamos Scientific Lab., N. Mex.). Phys. Chem. Solids, 26: 1075-8(June 1965).

The experimentally determined low temperature C_p vs. T curve of impure neptunium metal was found to exhibit irregular behavior. A small but persistent peak was found at about 85°K. The heat capacity data had considerable scatter between 75 and 140°K, and a change of slope was found in the C_p vs. T curve at about 240°K. The effects noted were real and correlated with anomalies in resistivity and magnetic susceptibility observed by others; they exhibited some similarity to effects observed in α-U and α-Pu. It was felt that the observed behavior was intrinsic to the neptunium metal and that results observed between 75 and 140°K would be clearer in pure metal. (auth)

34715 MICROWAVE ABSORPTION IN RARE EARTH METALS. Bagguley, D. M. S.; Liesegang, J. (Oxford Univ.). Phys. Letters, 17: 96-9(July 1, 1965).

Microwave power absorption was observed in single crystals of the rare earth metals terbium, dysprosium, and erbium. These absorption effects are magnetic-field dependent. The measurements were carried out at frequencies of 35.3 Bc and at 9.44 Bc over the temperature range 10 to 293°K. (J.F.P.)

34716 SPECIFIC HEAT OF ALPHA-MANGANESE AT LIQUID-HELIUM TEMPERATURES. Guthrie, G. L. (Carnegie Inst. of Tech., Pittsburgh and General Atomic Div., General Dynamics Corp., San Diego, Calif.); Friedberg, S. A.; Goldman, J. E. Phys. Rev., 139: 1200-2 (Aug. 16, 1965).

The heat capacities of two independently prepared specimens of α-Mn were measured between 1.75 and 4.2°K. The coefficient of the contribution linear in T is found to be $(30.6 \pm 1.5) \times 10^{-4}$ cal/mole(°K)^2. This value is in reasonable agreement with that determined by Booth, Hoare, and Murphy from measurements made in the liquid-hydrogen range. (auth)

34717 HIGH TEMPERATURE, SMALL DIAMETER, RADIAL HEAT FLOW THERMAL CONDUCTIVITY APPARATUS. Glassbrenner, C. J. (General Electric Research Lab., Schenectady, N. Y.). Rev. Sci. Instr., 36: 984-90(July 1965).

A high temperature thermal conductivity apparatus was designed and built. The apparatus employs a cylindrical geometry and radial heat flow and is accurate to ±5%. The thermal conductivities of germanium and silicon from 300°K to their respective melting points were measured with this apparatus. The special problems of high temperature measurements encountered with the apparatus are reviewed and discussed. In solving the high temperature measurement problems the eutectic temperatures of two germanium alloys (on the germanium-rich side of the phase diagram) were measured to about ±3°C. These are 909°C for germanium-iridium, and 932°C for germanium-tanta-

lum. Germanium and molybdenum did not react noticeably. (auth)

34718 LOW-ENERGY ELECTRON DIFFRACTION AND PHOTOELECTRIC STUDY OF (110) TANTALUM AS A FUNCTION OF ION BOMBARDMENT AND HEAT TREATMENT. Boggio, J. E.; Farnsworth, H. E. Surface Sci., 1: 399-406(Oct. 1964).

Electron diffraction studies were made of the stability of the closely packed ⟨110⟩ face of Ta after heat treatment up to 1400°C and argon ion bombardment at energies of 200 to 2000 ev for 264 min. Measurements were made of the structure and work function of the ⟨130⟩ and ⟨310⟩ facets produced by bombardment. (Rev. Metal Lit., 22: No. 3, (Mar. 1965))

34719 EFFECT OF SHAPING ON THE MICROSTRUCTURE AND THE MECHANICAL PROPERTIES OF URANIUM. Storr, J. A. Tech. Mod., 56: 393-402(Oct. 1964).

The principal factors permitting a high combustion rate for a uranium metal fuel element to be obtained are low grain size, grain size stability with temperature, and good mechanical properties, particularly resistance to creep and the absence of residual textures. The main methods of shaping are reviewed, and the results obtained with technically pure uranium and very slightly alloyed uranium, either through the addition of a single element such as molybdenum, which gives fuels capable of being used as-cast in certain cases, or through a number of additive elements, which enhance the possibility of refining through hardening are indicated. (Summaries Articles French Tech. Press)

34720 CONDENSED-PHASE RELATIONS IN THE SYSTEM Co–W–O AT HIGH TEMPERATURE (1000° TO 1700°C). Phillips, Bert; Chang, Luke L. Y.; Scroger, Margaret G. (Tem-Pres Research, Inc., State College, Penna.). Trans. Met. Soc. AIME, 233: 1220-6(July 1965).

Using the sealed-system technique, isothermal sections at 1000, 1400, and 1700°C for the system Co–W–O were determined. The equilibrium data were obtained by microscopic and x-ray diffraction examination of samples, which were equilibrated in pellet form in sealed capsules and subsequently quenched. The only ternary phase in the system was $CoWO_4$, which melted congruently at approximately 1280°C. At 1000°C, this ternary phase existed in equilibrium with all the alloys and oxide compounds in the bounding binary systems. At 1400°C, liquid formed in this oxygen-rich region near the $CoWO_4$ composition and only one phase assemblage in the system ($W + WO_2 + W_6Co_7$) contained no liquid. At 1700°C, tungsten was the only solid phase which was stable, and a large range of compositions melted to two liquids, one metallic and one oxidic. The sealed-system method of equilibration prevented the determination of the partial pressure of oxygen and the total gas pressure over the condensed phases at equilibrium. It was indicated that both the partial pressure of oxygen and the total pressure of the gas phase must increase as compositions change from the W-Co binary toward the oxygen apex and as temperatures increase. (auth)

34721 THE PLUTONIUM-INDIUM SYSTEM. Ellinger, F. H.; Land, C. C.; Johnson, K. A. (Los Alamos Scientific Lab., N. Mex.). Trans. Met. Soc. AIME, 233: 1252-8(July 1965). (LA-DC-6913)

The Pu–In phase diagram was determined by thermal, filtration, micrographic, and x-ray diffraction methods. This alloy system is characterized by limited solubility of indium (~2 at. %) in δ and ε plutonium, one eutectic, and five intermediate phases. Of the latter, PuIn and $PuIn_3$ melt congruently, and Pu_3In, Pu_3In_5, and the high-temperature η solid solution are formed peritectically. The η phase decomposes eutectoidally into Pu_3In and PuIn at 865°C. Although the δ phase can readily be retained to room temperature, it is not thermodynamically stable below 300°C. (auth)

34722 SOLID-STATE ELECTRODIFFUSION IN GAMMA-CERIUM, GAMMA-URANIUM, AND EPSILON-PLUTONIUM. Moore, R. H.; Smith, F. M.; Morrey, J. R. (Battelle-Northwest, Richland, Wash.). Trans. Met. Soc. AIME, 233: 1259-65(July 1965).

Electrodiffusion in γ-cerium reported by Henrie was confirmed and a preliminary estimate made of the relative rates of electrodiffusion of iron, cobalt, and nickel. These diffuse to the anode at rates decreasing in that order. In addition, copper and manganese exhibited slow, but detectable, diffusion to the anode and molybdenum exhibited detectable diffusion to the cathode. The electrodiffusion of carbon, zirconium, antimony, magnesium, and silicon in γ-cerium could not be detected. Iron and cobalt diffused in γ-cerium at rates proportional to the current density and with no apparent dependence on temperature. Decreasing polarization of iron and cobalt with increasing temperature, which cancels the expected rate increase, would account for this behavior. The electrodiffusion rate of iron in γ-uranium and in ε-plutonium was measured. Diffusion of iron was anode-directed. Tin was found to diffuse to the cathode, in γ-uranium, at an appreciable rate. In all of these solvent metals, negative ions diffused to the anode and positive ions to the cathode. The potential field effect appeared to account satisfactorily for these results. (auth)

34723 PHASE EQUILIBRIA IN YTTRIUM-RICH TERNARY ALLOYS CONTAINING ALUMINUM AND CARBON. Rosen, S.; Sprang, P. G. (Pratt and Whitney Aircraft, North Haven, Conn.). Trans. Met. Soc. AIME, 233:1265-9 (July 1965).

The Y–Al–C ternary phase diagram for the composition range from 55 to 100 at. % Y and for a temperature of 950°C was constructed from metallographic and x-ray diffraction data. The significant features of the isothermal section presented are the small solubility of aluminum in the binary Y_3C phase and the presence of a ternary carbide phase with a small homogeneity range around the composition Y_3AlC. The similarity in structure and composition between these two carbide phases is discussed in the light of the miscibility gap that exists between room temperature and 1300°C, which was the temperature range studied. (auth)

34724 LOW-TEMPERATURE MECHANICAL PROPERTIES OF A SOLUTION-HARDENED NIOBIUM (COLUMBIUM) ALLOY. Harris, B.; Peacock, D. E. (Pratt and Whitney Aircraft, North Haven, Conn.). Trans. Met. Soc. AIME, 233: 1308-13(July 1965).

The mechanical behavior of a niobium alloy containing 20 wt % Ta, 15 wt % W, and 5 wt % Mo was studied in the temperature range from 77 to 423°K. All specimens tested, apart from those into which oxygen was introduced deliberately, were fully recrystallized at 1500°C, had an average grain diameter of approximately 0.03 mm, and a combined carbon, oxygen, nitrogen, and hydrogen content of not more than 250 ppM. The mechanical behavior of this alloy was found to be similar in some respects to that of unalloyed bcc transition metals. Both yield and flow stresses were sensitive to changes in deformation rate and both increased rapidly as the temperature was lowered below 150°C. A detailed examination revealed, however, that most of the temperature dependence of the yield stress could be accounted for by the temperature dependence of the elastic modulus, which was not true of the unalloyed metals. In tension at moderate strain rates, the transition from ductile to brittle behavior occurred just below room temperature but increasing the oxygen content from 190 to 400 ppM raised the transition temperature to about 400°K. (auth)

34725 PREFERRED ORIENTATION IN ALPHA PLUTONIUM. Bronisz, S. E.; Tate, R. E. (Los Alamos Scientific Lab., N. Mex.). Trans. Met. Soc. AIME, 233: 1396-9(July 1965).

Some α-plutonium samples possessing a strong growth texture were produced by allowing them to transform under pressure from β to α. A fiber texture with [010] parallel to the pressure axis resulted. The textured samples are expected to be useful in determining the effects of crystallographic orientation on the physical properties of α-plutonium, and initial results of measurements of resistivity and mechanical properties are described. (auth)

34726 Pu-Cd SYSTEM: THERMODYNAMICS AND PARTIAL PHASE DIAGRAM. Johnson, Irving; Chasanov, Martin G.; Yonco, Robert M. (Argonne National Lab., Ill.). Trans. Met. Soc. AIME, 233: 1408-14(July 1965).

The thermodynamics of the cadmium-rich portion of the Pu–Cd system were studied with a high-temperature galvanic-cell method. The partial phase diagram of the Pu–Cd system was determined. The existence of the intermediate phases $PuCd_{11}$ (cubic $BaHg_{11}$ structure, a_0 = 9.282) and $PuCd_6$ (cubic, $CeCd_6$ structure, a_0 = 15.59) was established. The existence of at least one other intermediate phase richer in plutonium was indicated. $PuCd_{11}$ was found to peritectically decompose into $PuCd_6$ and liquid at 406 ± 2°C. The solubility of plutonium in liquid cadmium may be represented by the equations: (355 to 399°C) log (at. % Pu) = $6.223 - 4282T^{-1}$ and (399 to 632°C) log (at. % Pu) = $5.148 - 5277T^{-1} + 1.156 \times 10^6T^{-2}$. (auth)

34727 CONDENSED-PHASE RELATIONS IN THE SYSTEM Mo–O. Phillips, Bert; Chang, Luke L. Y. (Tem-Pres Research, Inc., State College, Penna.). Trans. Met. Soc. AIME, 233: 1433-6(July 1965).

The method of sealed-system equilibration was applied to the study of the condensed-phase relations in the system Mo–O. Four stable compounds were encountered: MoO_2, MoO_3, and phases very close to Mo_4O_{11} and Mo_9O_{26} in composition. Data are presented in tables and graphs. (M.C.G.)

34728 PRESSURE OF SATURATED ERBIUM, SAMARIUM AND YTTERBIUM VAPOR. Kruglykh, A. A.; Kovtun, G. P.; Pavlov, V. S. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Ukr. Fiz. Zh., 10: 432-5 (Apr. 1965). (In Ukrainian)

The pressure of saturated erbium, samarium, and ytterbium vapor was determined over temperature ranges of 915 to 1180, 484 to 721, and 390 to 494°C respectively by Knudsen's effusion method by the difference in weight of the effusion cell before and after the experiment. The results obtained are well described by the following equations: for erbium log P_{mm} = 6.9 – (13230/T); for samarium log P_{mm} = 7.4 – (8703/T); for ytterbium log P_{mm} = 8.5 – (7745/T). On the basis of these equations the sublimation heats were determined as 60.53, 39.8, and 35.4 cal/mole for erbium, samarium, and ytterbium respectively. The sublimation entropy of erbium is 18.4 cal/mole deg.; of samarium 20.7 cal/mole deg.; of ytterbium, 25.6 cal/mole deg. (auth)

34729 THE HYPERFINE INTERACTION BETWEEN NUCLEONS AND HOLES OF SILICON, AND THE NUCLEAR MAGNETIC RELAXATION IN THE p-TYPE SILICON. Kan, Tze-chao (Peking Univ.). Wu Li Hsueh Pao, 21: 691-706 (Apr. 1965). (In Chinese)

The hyperfine interaction of the carriers in semiconductors (involving the Fermi contact and noncontact terms) was treated by a "pseudo-contact interaction", which acts on the effective mass wave function. For the ^{29}Si nucleons and the holes in silicon, it can be represented by $\{S_1(J_x\mu_{nx} + J_y\mu_{ny} + J_z\mu_{nz}) + S_2(J_x^3\mu_{nx} + J_y^3\mu_{ny} + J_z^3\mu_{nx})\}\,\sigma\,(r - r_n)$. The coupling parameters S_1 and S_2 are certain integrals connecting the Bloch functions of the top of the value band, generally $S_2 \approx 0$. Using this formula, the nuclear magnetic relaxation in p-type silicon was treated and, an expression was obtained for the relaxation time. The value of the parameter S_1 was determined from the relaxation time and from the spin-orbit splitting value at the valence band top. (auth)

34730 THE INFLUENCE OF THE IMPURITY SCATTERING ON THE PROPERTIES OF TWO-BAND SUPERCONDUCTORS. Yu, Luh; Gu, Ben-yuan. Wu Li Hsueh Pao, 21: 824-38(Apr. 1965). (In Chinese)

A simple two-band model was used to investigate the influence of the multiconnectivity of the Fermi surface on the properties of superconductors. It was shown that the effect is analogous to that of anistropy. The effect of impurity scattering was considered by a Green's function method. There is a unique energy gap for both bands in the presence of impurities. The new gap parameter is larger than the smaller one of the two gaps in the pure case. The critical temperature T_c, critical magnetic field, and its temperature coefficient near T = 0°K are lowered with doping, while the jump in specific heat at the transition point is raised. The combined measurement of the relative changes of these quantities should provide a direct verification of the theoretical calculations. The properties of heavily doped two-band superconductors are identical with those in the single-band case. Furthermore, the results obtained were used to discuss the tunnelling experiment on Pb films and the anomaly of critical temperature in the alloy systems of In-Sn and In-Pb. (auth)

34731 DIFFERENTIAL THERMAL ANALYSES AND HIGH TEMPERATURE X-RAY STUDY OF URANINITE. Atia, Abdel Kadir Mohamed Hassan. Thesis, New York, Columbia Univ., 1964. 108p.

Phase transformations in UO_2 up to 1000°C were studied by differential thermal analysis and by high temperature x-ray diffraction. In the absence of thorium and rare earths, when heated in air, uraninite was characterized by an exothermic reaction at 685 to 710°C. This reaction involved the transformation of UO_2 to U_3O_8. The change could be detected with the high-temperature x-ray camera, where diffractometer lines indicated that U_3O_8 starts to form at 500 to 600°C and exists together with UO_2 up to 700°C when UO_2 transforms completely to U_3O_8. In the presence of thorium the UO_2 to U_3O_8 reaction was suppressed because of the substitution of U^{4+} by Th^{4+}, which tended to stabilize the UO_2 structure. The x-ray data showed that a large content of rare earth elements breaks down the UO_2 structure abruptly at 610°C. Samples high in these elements gave more or less smooth DTA (differential thermal analysis) curves without exothermic or endothermic reactions when heated in air. Artificial UO_2 was characterized by an endothermic reaction at 340°C caused by the formation of a tetragonal phase. This was followed by an exothermic reaction at 385°C indicating the transformation of the tetragonal to the hexagonal U_3O_8 phase, which remained stable up to 1000°C. Artificial UO_3 was characterized by an exothermic reaction at 690°C at which it transformed to U_3O_8, which remained stable up to 1000°C. Artificial U_3O_8 yielded a broad exothermic peak throughout the whole range of heating indicating the gradual transformation of the orthorhombic lattice to a hexagonal cell. Change in color caused by oxidation of U^{4+} to U^{6+} was an accompanying indicator of phase transformation. (Dissertation Abstr.)

34732 ISSLEDOVANIYA METALLOV V ZHIDKOM I TVERDOM SOSTOYANIYAKH. (Investigation of Liquid- and Solid-State Metals). Samarin, A. M. (ed.). Moscow, Izdatel'stvo Nauka, 1964. 280p.

Twenty-one articles are included on the principles of physico-chemical metallurgical processes and physical and chemical properties of metals and alloys. Separate abstracts are prepared for three articles of special interest. (R.V.J.)

For abstracts of individual sections see: 34648, 34733, and 34734.

34733 STRUCTURE AND PHYSICO-CHEMICAL PROPERTIES OF HIGH-MELTING TRANSITION METALS AND A^IB^{VII}, $A^{II}B^{VI}$, AND $A^{III}B^V$ TYPE COMPOUNDS. Grigorovich, V. K. pp 169-98 of Issledovaniya Metallov v Zhidkom i Tverdom Sostoyaniyakh. Moscow, Izdatel'stvo Nauka, 1964. (In Russian)

The nature of the interatomic bond of high-melting compounds of transition metals and A(I)B(VII), A(II)B(VI), and A(III)B(V) type compounds was studied and their chemical and physical properties were correlated to their crystal and electron structure. (R.V.J.)

34734 PROPERTIES OF TERNARY NIOBIUM, TANTALUM AND MOLYBDENUM ALLOYS. Vasil'eva, E. V.; Prokoshkin, D. A. pp 248-54 of Issledovaniya Metallov z Zhidkom i Tverdom Sostoyaniyakh. Moscow, Izdatel'stvo Nauka, 1964. (In Russian)

Effects of alloying on the mechanical properties of Nb–Mo were studied using a specimen with 10 wt % Mo and 0.25 to 15 wt % Ta and with 5 wt % Mo and 10 wt % Ta. The specimens prepared in an arc furnace in pure argon

atmosphere were cut by electric spark method and tested for heat resistance and hardness. (R.V.J.)

34735 COLUMBIUM–TANTALUM BASE ALLOY. Duffek, Edward F. Jr. (to California Research Corp.). U. S. Patent 3,186,837. June 1, 1965. Filed Feb. 28, 1961.

A Nb–Ta-base alloy is reported to be resistant to corrosion by either hot oxidizing or non-oxidizing acids, to have good ductility, and to be very suitable for use as lining material for vessels or other equipment. The alloy consists in wt % of 20–45% Ta; 2–15% Ti; sufficient Ni to give a two-phase alloy, 1–10%, preferably 3–5%; up to 7.5% Mo; up to 7.5% W; up to 10% V; up to 4% Sn; and the balance Nb. The alloy must contain at least 35 wt % Nb and not more than 15 wt % Mo, W, V, and Sn combined. (B.L.M.)

Radiation Effects

See also CHEMISTRY — Radiation Chemistry.

Refer also to abstracts 35378 and 35611.

34736 (AD-612463) NUCLEAR RADIATION EFFECTS ON INFRARED MATERIALS AND COMPONENTS. PART I. EFFECTS OF GAMMA RADIATION ON INFRARED TRANSMITTING MATERIALS AND FILTERS. Shaw, Clyde C.; Krogstad, R. S. (Lockheed Aircraft Corp. Missiles System Div., Sunnyvale, Calif.). June 16, 1958. 23p. (LMSD-5014) $1.00(CFSTI).

The results of a survey of ^{60}Co gamma radiation effects on the optical properties of a number of infrared transmitting materials and filters are presented. The study shows that, with few exceptions, the materials and filters are insensitive to gamma radiation at a dosage level of 10^7 R or more. (auth)

34737 (AD-612810) THERMAL EFFECTS IN RADIATION DAMAGE EXPERIMENTS. Scientific Report No. 4. Sherman, Charles H. (Parke Mathematical Labs., Inc., Carlisle, Mass.). Oct. 1964. Contract AF19(628)-2419. 44p. (AFCRL-64-935) $2.00(CFSTI).

A rather rigorous calculation of the one-dimensional steady-state temperature distribution in a radiation damage test strip is described. The analysis includes the temperature dependence and specimen dependence of the thermal conductivity, as well as the effect of radiation damage on the thermal conductivity. The thermal calculations are used to determine the electrical resistance of the sample during the irradiation, and various uses for such calculations in interpreting experimental data are discussed. Numerical illustrations are carried out for a platinum sample. (auth)

34738 (BNL-8222) INTERSTITIAL REACTIONS IN GRAPHITE DURING NEUTRON REIRRADIATIONS. I. STEADY STATE CONSECUTIVE REACTIONS. Schweitzer, Donald G. (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 21p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Property changes in alternately irradiated and annealed graphite are explained by postulating the existence of consecutive reactions between mobile and immobile interstitials during reirradiations. Saturation in dimensional and stored energy changes is interpreted as evidence for steady-state concentrations of various interstitial entities. The removal of radiation damage by the technique of alternate irradiations and anneals is shown to be consistent with the solution of the kinetic equations for the postulated reactions. (auth)

34739 (BNL-8223) INTERSTITIAL REACTIONS IN GRAPHITE DURING NEUTRON REIRRADIATIONS. II. NON-STEADY STATE CONSECUTIVE REACTIONS. Schweitzer, Donald G. (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 23p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Empirical kinetic equations obtained from dimensional changes can be fitted to the model for radiation damage in alternately irradiated and annealed (AIA) graphite described in previous work. The assumptions used in matching theory and experiment are discussed. (auth)

34740 (BNWL-58) FISSION PRODUCT DISTRIBUTION IN IRRADIATED UO_2. Bates, J. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1965. Contract AT(45-1)-1830. 26p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The gross fission product relocation which occurs during high-temperature irradiation of UO_2 fuel elements was studied using autoradiography, microdrilling, and radiochemical analysis. The fission product distribution is related to the characteristic microstructures of the UO_2 formed during irradiation. Annular bands of high fission fragment concentration are observed symmetrically about the thermal center with depletion in the large columnar grains. The distribution and concentration vary from fission product to fission product. Fission products concentrate in bands associated with metallic uranium inclusions that are formed during irradiation. Plutonium also migrates during irradiation. (auth)

34741 (BNWL-79(p.3.1-22)) PHYSICAL METALLURGY. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The recovery processes in Mo doped with 10 and 450 ppm C and irradiated to 10^{20} nvt (E > 1 Mev) were studied by transmission electron microscopy. Spot and loop defects, which were present after annealing at 750°C, disappeared after annealing at 1000°C and stable configurations of dislocation nodes formed. Length change and lattice parameter measurements were made on single crystal rods of Mo irradiated to 7×10^{18} nvt. After a 14 hr anneal at 200°C, 60% recovery of macroscopic length and 0.003% recovery of lattice parameter occurred. Migrating vacancies were responsible for the change. Thermally-activated deformation in unirradiated polycrystalline Mo between 223 and 350°K appeared to occur by motion of jogs in screw dislocations. Examination of high purity U and Al–Fe–Si–U alloy specimens operated at 1000 psi and 575°C to 0.13 at. % burnup showed that pressure inhibits swelling. The total strain accompanying the alpha-beta-alpha transformation cycle of Pu was investigated as a function of tensile stresses and transformation rates. Excess creep strain occurred primarily during the later stages of the alpha-beta transformation and the early stages of the beta-alpha transformation. The temperature for the beginning of the beta-alpha transformation was increased by both compressive and tensile loading. Application of tension during the alpha-beta transformation and compression during the beta-alpha transformation enhanced the development of a fiber texture in Pu. After an exposure of 5×10^{18} nvt, bulk Fe specimens contained no defect clusters normally visible as spots or loops by transmission electron microscopy. (W.L.G.)

34742 (BNWL-79(p.4.1-30)) REACTOR METALS RESEARCH. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Specimens of Hastelloy N irradiated at 280°C and tested at room temperature showed increases in strength and slight decreases in ductility properties. Specimens tested at 650°C showed marked decreases in ductility. Similar results were found for specimens of Hastelloy X-280 irradiated under the same conditions. Additional specimens of Hastelloy X-280 irradiated at 740°C and tested at 650°C showed a severe decrease in ductility of the alloy. Specimens of Incoloy 800 and Inconel 600 were irradiated in the mill annealed, 20% cold worked, and solution treated conditions and tested at 650°C. Substantial differences in the postirradiation properties were found with marked decreases in ductility common to all specimens. For both materials, specimens in the solution treated conditions maintained the best ductility characteristics but were substantially lower in strength. Additional specimens of Inconel 600 were irradiated at 280°C and tested at 650°C. Results from these tests showed a considerable increase in the strength and ductility at an exposure of 5.86×10^{20} nvt. Inconel 625 specimens were irradiated at 50, 280, 580, and

740°C and tested at room temperature and 650°C. The room temperature test results for specimens irradiated at 50 and 280°C show some increase in strength with small decrease in ductility. Specimens irradiated at 50°C showed the greater effect. The effects of irradiation temperature upon the room temperature properties of irradiated material show a large decrease in ductility in materials irradiated above 580°C. Similarly specimens irradiated at 280°C and tested at 650°C show large decreases in both strength and ductility at exposures of 1.46×10^{21} nvt. Reduced rupture life and ductility at failure were observed in type 304 stainless steel for the in-reactor 550°C, 30,000 psi creep test as compared to the out-of-reactor test. The in-reactor creep strain at failure was 3 to 4% with a failure time of 760 hr. The out-of-reactor test had accumulated 3500 hr of test time with a creep strain of 4.8% without failure. Tensile tests were performed on the BONUS transition joint specimens irradiated to exposures up to 2.5×10^{20} nvt (E > 1 Mev). Specimens exposed in the out-of-reactor loop and in the as-received condition were also tested. Tests were performed at 550°F and at room temperature on specimens in each condition. Preliminary results indicate there is no change in properties due to exposure in the out-of-reactor loop. Tests on the irradiated samples resulted in failure entirely through the Zircaloy-2 portion of the specimen. These failures were of an extremely brittle nature for both the room temperature and 550°F tests. Uniform elongations of less than 1% and total elongations of less than 2% were observed. (W.L.G.)

34743 (GEAP-4754) TENSILE PROPERTIES OF FUEL CLAD MATERIALS IRRADIATED IN SUPERHEAT ENVIRONMENTS. Beaudreau, B. C.; Busboom, H. J.; Comprelli, F. A.; Spalaris, C. N. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Apr. 1965. Contract AT(04-3)-189. 42p. Dep.(mn); $2.00 (cy), 1(mn) CFSTI.

The effect of irradiation upon the tensile properties of Incoloy-800, Inconel-600, Hastelloy-X, AISI-406, and several 300-series stainless steels was studied as a function of accumulated neutron exposures and tensile test temperature. Tensile tests were conducted at temperatures of 75, 1100, and 1300°F after accumulated neutron exposures of 0.6 to 4×10^{20} nvt ($E_n \geq 1$ Mev) in separate experiments. Both pre-cut coupons and tensile specimens, machined from irradiated fuel sheaths, were tested. (auth)

34744 (HW-84384(p.6.1-9)) GAS-COOLED REACTOR STUDIES. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Studies are described on thermal conductivity of EGCR graphite, radiation effects on tensile strain limits of graphite, and radiation effects on boronated graphite. (J.R.D.)

34745 (HW-84384(p.8.1-5)) IRRADIATION EFFECTS ON MATERIALS AND MATERIALS DEVELOPMENT. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Investigations of swelling in irradiated fissionable materials are described along with irradiation damage to Ni-base alloys and damage mechanisms. In-reactor measurements of mechanical properties are reported, and irradiation facilities operation is described. Environment effects on corrosion rates were investigated. Activities in ATR gas loop support and PRP materials development are reported. (J.R.D.)

34746 (N64-33783) INTRODUCTION TO NUCLEAR PROPULSION. LECTURES 19 AND 20. RADIATION DAMAGE AND EFFECTS. Beeler, J. R. Jr. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 1963. Contract NAS8-5215. 72p. (GEMP-190m; NASA-CR-52949) $3.00(CFSTI).

Radiation damage and effects in crystals are discussed. More complicated radioinduced processes in organic materials and polymers are also discussed. Temperature effects on radiation are considered. (M.O.W.)

34747 (NAA-SR-10612) RADIATION DAMAGE IN SILICON: NEUTRON SPECTRUM CONSIDERATIONS. Robinson, M. N. (Atomics International, Canoga Park, Calif.). June 10, 1965. Contract AT-11-1-GEN-8. 18p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

A spectrum normalization scheme for radiation damage in silicon is proposed and applied to some representative test spectra. It is shown that significant differences may be predicted for data obtained in different environments. This technique should be effective in resolving such apparent contradictions in the data, and it should also permit a more accurate prediction than heretofore of the response of silicon semiconductors to new radiation environments. (auth)

34748 (NRL-Memo-1596) IN-REACTOR FATIGUE TESTS OF A302-B STEEL REPRESENTING THE ELK RIVER REACTOR PRESSURE VESSEL. Hawthorne, J. R.; Steele, L. E. (Naval Research Lab., Washington, D. C.). Feb. 15, 1965. Contract AT(11-1)-1369. 17p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Dynamic low cycle fatigue tests of specimens from a 3-inch thick A302-B plate representative of the Elk River Reactor (ERR) pressure vessel were performed in-reactor at 550°F. The test apparatus provided for the simultaneous testing of fifteen sheet-type specimens, representing five average strain amplitudes, in reverse bending. The total neutron dosage received by individual specimens at failure ranged from 7.6 to 8.8×10^{18} n/cm^2 (>1 Mev), as determined from iron and titanium dosimeter wires included in the experiment. The comparison of data derived from in-reactor tests and out-of-reactor control tests performed on duplicate equipment did not reveal an effect of irradiation on fatigue properties. (auth)

34749 (ORNL-3812(p.87-120)) RADIATION CHEMISTRY. (Oak Ridge National Lab., Tenn.).

A series of in-pile tests of the compatibility of Molten-Salt Reactor materials was completed. Earlier tests in the series furnished evidence, such as CF_4 and F_2 in the gas phase, that raised questions about the stability of the fuel under irradiation. Favorable answers to these questions were confirmed by the most recent test. Off-gas from in-pile capsules was analyzed for CF_4, but none could be detected. The maximum sensitivity of the measurements was such that CF_4 would have been detected if its rate of production was 0.1% of that of Xe. This is lower by a factor of 1000 than the rate at which CF_4 production in the MSRE would be of practical significance. The amount of U deposited from the fuel on graphite proved to be negligibly small, again in contrast to the behavior in earlier tests carried out without heaters. No evidence of radiation-induced incompatibility could be found. Fission-product I_2 and Te were partially removed from capsules that were swept with He during the in-pile exposure. (J.R.D.)

34750 (ORNL-tr-687) RADIOACTIVITY—INVERSION IN BIOTITE SUBJECTED TO ALPHA-RAYS. Jedrzejowski, M. H. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.) from Compt. Rend., 186: 135-7(1928). 4p. Dep.(mn); $1.10(fs), $0.80(mf) JCL

An evaluation was made of the possibility of inversion in the pleochroic halos produced by α rays from an activated center in biotites. A very thin glass vessel filled with radon was placed on a biotite sheet for 5 days, and the degree of blackening was measured relative to an unexposed sheet. The results confirm the inversion effect and indicate that age determinations using the halos may be erroneous. (D.L.C.)

34751 INTERNAL STRAIN DURING NON-UNIFORM SWELLING OF FISSIONABLE MATERIAL. Likhachev, Yu. I.; Zvonarev, V. P.; Pupko, V. Ya. At. Energ. (USSR) 18: 483-7(May 1965). (In Russian)

The nonuniform swelling of fissionable material produced by a neutron flux and causing nonuniform distribution of fission products across the fuel element was analyzed. A method is given for calculating the strain in fuel elements caused by nonuniform swelling of the fissionable materials. (R.V.J.)

34752 GAMMA-INDUCED ELECTRIC CONDUCTIVITY IN FUSED SILICA. Bagge, E.; Janssen, U. (Gesell-

schaft fuer Kernergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Atomkernenergie, 10: 197-9(May-June 1965). (In German)

The γ-induced electric conductivity of fused silica of different qualities was measured in the dose-rate range from 1 to $2 \cdot 10^6$ r/h. The sensitivity of different probes varied within two orders of magnitude without correlation to the degree of purity of the quartz glass. (auth)

34753 THERMAL EFFECT IN GRAY CAST IRON TREATED BY GAMMA QUANTUM IRRADIATION. Slyusar, B. F.; Shalaev, A. M. (Inst. of Physics of Metals, Academy of Sciences, Ukrainian SSR). Fiz. Metal. i Metalloved., 19: 636-7(Apr. 1965). (In Russian)

Electron irradiation of white iron below 100°C hardens the iron (20 to 40 kg/mm² increase in Brinell hardness) with formation of lattice defects. In order to determine the type of defects, cast iron (perlite plus graphite, 3.6% carbon, 2.3% silicon, 0.5% manganese, 0.14% phosphorus, trace of sulfur) samples were irradiated (^{60}Co) for 70 and 170 hr at 130 R/sec and then gradually heated in a differential calorimeter to 700°C. Between 100 and 300°C there was a definite release of heat, 0.15 cal/g for the 70-hr-irradiated material and 0.45 cal/g for the 170-hr-irradiated material. This effect is related to the disappearance of the lattice defects formed on irradiation. The results are in agreement with work on samples of iron and nickel, in which release of heat in the region 100 to 300°C was observed in the annealing of excess vacancies. The value of 0.45 cal/g for released heat corresponds to 0.07% excess vacancies. (TTT)

34754 ABSORPTION SPECTRA OF IRRADIATED SILICATE CERAMICS. Belousov, V. M.; Kirov, S. M. (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 2, 175-7(1965). (In Russian)

High-energy-irradiated ceramics show color changes, which are usually explained as due to formation of absorption centers. In this connection changes in optical absorption of ceramics (62% SiO_2, 31% MgO, 5% Al_2O_3, 2% B_2O_3) gamma irradiated with ^{60}Co, 200-kev gamma, 15-Mev betatron, and 3.4-Mev protons were studied. The absorption spectrum induced by the irradiation was continuous. The darkening increased with increased irradiation dose. The curves of percentage of reflection vs wave length were similar for the four kinds of irradiation, and therefore the damage was probably similar. The continuity of the absorption spectrum might be explained by a polymorphic conversion to the crystalline phase without change in chemical composition or by radiolysis with or without formation of a new phase. Detailed infrared reflection studies of the absorption spectrum showed no qualitative differences from 750 to 25,000 mμ. This indicates no polymorphic conversion or radiolysis, but formation of a new phase. Microscopic examination of irradiated ceramics in transmitted light showed the presence of silicon particles, whose dimensions increased with increasing irradiation dose. (TTT)

34755 REDUCTION IN DUCTILITY OF AUSTENITIC STAINLESS STEEL AFTER IRRADIATION. Higgins, P. R. B.; Roberts, A. C. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 206: 1249-50 (June 19, 1965).

Samples of 20% Cr, 25% Ni : Nb stabilized steel foils were irradiated with α particles and lithium ions and the relative effect on the ductility at 750°C was investigated. The irradiations produced slight increases in the 0.2% proof stresses, but there was no significant change in the ultimate tensile stress; however, the ductilities to fracture were significantly reduced. The ductility was affected to a larger extent by the presence of helium than by a similar concentration of Li. It appears that to obtain the same ductility loss the lithium concentration must be at least two orders of magnitude greater than that of He. (P.C.H.)

34756 EMBRITTLEMENT OF STAINLESS STEELS AND NICKEL-BASED ALLOYS AT HIGH TEMPERATURE INDUCED BY NEUTRON RADIATION. Barnes, R. S. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 206: 1307-10(June 26, 1965).

The materials examined were initially limited to one type of stainless steel and one nimonic alloy, and the neutron irradiations were performed at reactor ambient temperature, ~40°C. These experiments established that neutron doses as small as 8×10^{18} cm^{-2} for the former and 3×10^{17} cm^{-2} for the latter materials were sufficient to cause an easily detectable embrittlement on tensile testing at 750°C. The tensile properties were examined over the range from room temperature to 800°C. A hardening and a consequent decrease in ductility were detectable up to temperatures of ~500°C, where the effect annealed and the mechanical properties became indistinguishable from those of equivalent unirradiated samples. With the stainless steel increasing the neutron dose caused a decrease in the nonuniform elongation, but in general left the stress-strain curve unaltered, while with the nimonic alloy the ultimate tensile stress could also be reduced. The recovery of low-temperature hardness and ductility of about 500°C was consistent with radioinduced point defect clusters being the cause and indicated that high-temperature embrittlement was due to some other cause not readily recoverable by heating. The results were supported by later information obtained from experiments where the samples were irradiated at temperatures above 500°C. In most cases the ductility of these samples, when tested at high temperature, was scarcely distinguishable from similar samples irradiated cold. However, on testing below the irradiation temperature they showed no embrittlement. It was indicated that, in these irradiations, the transmutation of ^{10}B to helium and lithium was the reason for the embrittlement at high temperature. Helium, because of its insolubility and consequent tendency to form internal gas bubbles in solids, was likely to cause the embrittlement. Hydrogen produced by (n,p) reactions was likely to escape either during testing at high temperatures, or during irradiation at high temperatures. Consideration of the embrittling action of the helium bubbles on the grain boundaries showed that the low concentrations of helium were sufficient to cause embrittlement. (F.J.H.)

34757 ANNEALING INVESTIGATIONS IN HIGH DOSE GRAPHITE. Stagg, M. S.; Turnbull, J. A. (Berkeley Nuclear Labs., Gloucestershire, Eng.). Nature, 206: 64 (July 3, 1965).

Graphite crystals were irradiated to a total dose of 5×10^{20} N cm^{-2} at 200°C. After annealing at 2500°C in a carbon tube furnace flushed with argon, the crystals were found to contain a high density of large loops about 1000 Å diameter. The loops were found to be interstitial in character. Annealing loops with a radius smaller than a critical radius shrank, while those with a radius larger than the critical radius grew. (M.C.G.)

34758 ON THE INVESTIGATION OF IRRADIATION INFLUENCES ON SOLIDS BY TRANSMISSION ELECTRON MICROSCOPY. Lube, Frank (Universitat, Vienna and Zentrum fur Elektronenmikroskopie, Graz). Nukleonik, 7: 184-9(Apr. 1965). (In German)

It is shown, using the method of direct comparison for the irradiated and unirradiated state of the electron-microscopic preparation for the electron optical image, whether a change occurring in the preparation with alpha irradiation can be specifically established. The analysis of the irradiation experiments on gold films, whose production by vacuum resistance heating results in single crystal cleavage surfaces, yields the following results for a ^{210}Po source with average intensity of 10^{14} α/mm²: the irradiation with α-particles leads to local strains and displacements; the structure of the lattice defects could be determined; grain boundary displacement and grain size changes did not occur. (tr-auth)

34759 GROWTH OF MAGNESIUM OXIDE DURING NEUTRON IRRADIATION. Hickman, B. S.; Walker, D. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Phil. Mag. (8), 11: 1101-8(June 1965).

The macroscopic and x-ray growth of single crystal and polycrystalline magnesium oxide after neutron irradiation at 75–100°C was investigated. At doses below 10^{20} nvt the x-ray growth was found to exceed the macroscopic growth

by a small but significant amount. At doses above 10^{20} nvt the macroscopic growth continued to increase at a reduced rate but the x-ray growth decreased and rapidly became much less than the macroscopic growth. Annealing studies show that the recovery was dependent on dose and that the lattice parameter changes became negative before returning to the pre-irradiation value. An interpretation of the data is presented involving the formation of interstitial loops at doses above 10^{20} nvt and during annealing. Mean values of the distortion per defect are derived which correspond to the distortion averaged over all unannealed defects, whether isolated or clustered. For vacancies the distortion is a contraction having a maximum value of 0.4 atomic volumes and decreasing with increasing dose, whereas interstitials produce a dilatation of around 3 atomic volumes. The defect production rate is calculated to be 6–8 vacancies per fast neutron collision. (auth)

34760 NEUTRON IRRADIATION STRENGTHENING IN COPPER SINGLE CRYSTALS. Koppenaal, T. J. (Argonne National Lab., Ill.). Phil. Mag. (8), 11: 1257-88 (June 1965).

The temperature and strain rate dependence of the flow stress were measured from 4.2 to 373°K in neutron-irradiated copper single crystals as a function of neutron dose and solute additions. Between 77 and 373°K solutes have very little effect on the flow stress and its temperature dependence. At 4.2°K a large amount of solute, 7–14 at. %, lowers the flow stress of pure copper crystals. From these measurements an activation energy and activation volume were calculated. Both are solute independent and are analyzed on the basis of a stress dependence, rather than a temperature dependence. It is thus shown that the results can be explained by assuming a single-valued energy for the thermally activated deformation process, rather than by assuming an obstacle size spectrum. The experimental results are shown to be in rather good agreement with Fleischer's strengthening theory based upon tetragonal distortions. (auth)

34761 ANISOTROPY OF DEFECT FORMATION IN RADIATED SILICON. Fang, P. H. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Letters, 16: 216-17 (June 1, 1965).

Anisotropy in the formation of defects in Si radiated by high energy electrons is reported. This anisotropy is energy dependent: at 0.3 Mev, the degree of damage along the crystallographic orientation of (100) is least, higher along (110), and highest damage along (111). At 1.0 Mev, the order of damage is reversed: the damage along the (110) and (100) orientations is about the same, but along the (111) orientation the damage becomes less. The crossover point occurs near 0.5 Mev. (M.O.W.)

34762 SATURATION OF THE RESISTIVITY IN URANIUM IRRADIATED AT 4.5°K. Burger, G. (Technische Hochschule, Munich); Wenzl, H.; Isebeck, K.; Jousset, J. C.; Quere, Y. Phys. Letters, 16: 240-1(June 1, 1965).

Pure zone refined samples of uranium were irradiated in a thermal flux of 8×10^{12} n/cm^2 sec for about 7 hours. The increase of electric resistance due to fission fragment damage was measured during irradiation at 4.5°K and with a neutron flux kept constant to $\pm 5 \times 10^{-9}$. (M.O.W.)

34763 SPONTANEOUS RECOMBINATION OF FRENKEL PAIRS. Dettmann, K. (Inst. of Theoretical Physics and Technical School, Aachen). Phys. Status Solidi, 10: No. 1, 269-82(July 1, 1965). (In German)

The general equations are derived which describe the spontaneous recombination of Frenkel pairs for neutron and electron bombardment. The equations are solved by the superposition approximation in which third order densities are replaced by products of second order (pair) densities. The dependence of the normal defect densities on the initial interstitial-vacancy correlation is calculated. For electron irradiation only the stationary density is discussed. (auth)

34764 EFFECT OF ELECTRON IRRADIATION ON MECHANICAL PROPERTIES OF ALUMINUM SINGLE CRYSTALS. Ono, Kanji. Thesis, Evanston, Ill., Northwestern Univ., 1964. 105p.

Aluminum single crystals of 99.999% initial purity were irradiated at about 80°K with electrons having an incident energy of 1.0 Mev. An increase in flow stress measured at 77°K was always found after irradiation. When the irradiation was carried out in easy glide region, the increase was linearly proportional to defect concentration produced by the irradiation. The increase was strongly strain-rate dependent and recovered almost completely by annealing in Stage III. The extent of easy glide and the work-hardening rate in the easy glide were also increased. No yield point or yield drop was observed after the irradiation. Irradiation in the linear-hardening region resulted in a similar magnitude of flow-stress increase, but significant strain-rate dependence was not observed in this case. The work-hardening rate following irradiation decreased. When quench-hardened crystals were irradiated, the increase in flow stress was much smaller than the corresponding results in annealed crystals. On the basis of the distribution and concentrations of the defects produced by the irradiation, several possible models of the hardening effect were considered. It was concluded that the observed hardening effects are due to interstitials, which have migrated to dislocations during the irradiation. After irradiation in easy glide, the interstitials appeared to form superjogs on the dislocations that were dragged along the dislocations on resumption of plastic deformation. The magnitude of the observed hardening can be explained quantitatively by the superjog dragging mechanism with a reasonable choice of parameters. Annealing of the radioinduced hardening in the temperature range corresponding to Stage III can be explained only by vacancy migration to the interstitial superjogs. Various models of Stage III recovery were critically examined. The models that postulate interstitial migration in Stage III, such as the two-interstitial model, must be rejected at least in pure aluminum. Vacancy and divacancy migration mechanisms of Stage III recovery explained most satisfactorily the various observations. The yield point was observed after interruption of a tensile test. The magnitude of the yield point was much larger in irradiated crystals than in unirradiated crystals at the early stage of deformation and was strain-rate dependent. The interruption yield point due to irradiation was interpreted as being caused by Cottrell locking of interstitials, which were released from impurity trapping sites by glide dislocations. The magnitude of the yield point initially increased and saturated out at about one minute. After an interruption of not more than one minute, the stress-strain curve after passing the yield point coincided with the extension of the stress-strain curve prior to the interruption. After an interruption of more than one minute, however, the flow stress level was raised by the interruption, but the total increase in flow stress due to the interruption changed little. Consequently, the portion of the increase that did not remain after small amounts of deformation decreased. This shift to a permanent increase in flow stress, which was almost complete after a 5-min interruption, was interpreted as caused by interstitials, which migrated to dislocations to form Cottrell atmosphere around the dislocations and then precipitated in the form of superjogs on the dislocations. This can be considered as an additional support for the superjog dragging mechanism of the radiation-hardening mentioned above. (Dissertation Abstr.)

34765 TEMPERATURE AND ENERGY DEPENDENCE OF THE INTRODUCTION AND ANNEALING RATES OF ELECTRON-INDUCED DEFECTS IN n- AND p-TYPE SILICON. Novak, Robert Leonard. Thesis, Philadelphia, Univ. of Pennsylvania, 1964. 100p.

The introduction rate of electron-induced defects as a function of electron bombarding energy and irradiation temperature was studied in n- and p-type silicon. Measurements of the electrical resistivity and Hall coefficient were made on n- and p-type material before and after electron bombardment. The three main areas explored were: irradiation at 260°K by monoenergetic electrons over the energy range from 125 to 500 kev; electron irradiation over the temperature range from 79 to 300°K, and isochronal anneals in the temperature range from 100 to

325°K after irradiation at 79°K. The parameter used to measure the radiation damage was the defect introduction rate η (the number of carriers removed per unit volume by unit electron flux). These measurements yielded values for the threshold energy necessary to produce detectable changes in the electrical properties. The appearance of a damage threshold in n-type silicon occurred at an electron bombarding energy of 165 kev. The threshold in p-type material was observed at a bombarding energy of 220 kev. The energy and temperature dependence of the defect introduction rate was appreciably different in n- and p-type silicon. Experimental curves of defect introduction rate as a function of bombarding energy showed neither qualitative nor quantitative agreement with theoretical curves calculated from a relativistic Rutherford scattering formula. The defects responsible for carrier removal produced levels located 0.19 ev below the conduction band and 0.32 ev above the valence band in n- and p-type material, respectively. In n-type material irradiated at 79°K, no significant annealing occurred (as determined by isochronal anneals) until the temperature reached ~275°K. In p-type material significant annealing occurred in two stages, one relatively abrupt stage at 185°K and a more gradual stage setting in at 300°K. A model is proposed to explain how defect formation is affected by: vacancy-vacancy and vacancy-impurity interactions; temperature of bombardment, and the charge state of the vacancy and interstitial as initially produced in n- and p-type silicon. (Dissertation Abstr.)

34766 DEISTVIE IZLUCHENII NA POLUPROVODNIKI. (Radiation Effects on Semiconductors). Vavilov, V. S. Moscow, State Publishing House of Physico-Mathematical Literature, 1963. 264p.

An analysis was made of the physical concepts of electromagnetic and corpuscular radiation effects on semiconductors. Processes of electromagnetic absorption, photoionization, and ionization taking place during the passage of high-energy charged particles are studied, and recombination processes reversing the excited crystal to the equilibrium state are discussed. Data are given on the structural defects and changes in physical properties induced in semiconductors by strong irradiation with fast electrons, γ rays, neutrons, and heavy charged particles. 275 references. (R.V.J.)

34767 VZAIMODEISTVIE GAMMA-IZLUCHENIYA S VESHCHESTVOM. CHAST' 1. ISTOCHNIKI GAMMA-IZLUCHENIYA I ELEMENT-ARNYE PROTSESSY VZAIMODEISTVIYA GAMMA-LUCHEI S VESHCHESTVOM. (Interactions of Gamma-Radiation with Matter. Part 1. Sources of Gamma Radiation and Elementary Processes of Gamma Interactions with a Substance). Starodubtsev, S. V.; Romanov, A. M. Tashkent, Izdatel'stvo "Nauka" Uzbekskoi SSR, 1964. 251p.

Calculations and experimental data are given on the penetration of strong electromagnetic radiation through a substance, gamma transfer, and secondary emission processes. 253 references. (R.V.J.)

METEOROLOGY

See also GEOLOGY AND MINERALOGY — Site Survey and Selection.

Refer also to abstract 34378.

34768 (UCRL-11380) INTEGRATION OF THE SUTTON POINT SOURCE ATMOSPHERIC DIFFUSION KERNEL. Olander, D. R. (Lawrence Radiation Lab., Univ. of California, Berkeley). Apr. 16, 1964. Contract W-7405-eng-48. 15p. Dep (mn); $1.00(cy), 1(mn) CFSTI.

Sutton's formula is used in analyses of atmospheric transport of radioactive material following a nuclear accident. Calculations were made to examine the accuracy of the steady-state Sutton formula and to investigate the effect of a time-varying source on the validity of the approximate integral evaluation. (D.L.C.)

PHYSICS

General

Refer also to abstracts 34291 and 35615.

34769 (AD-612498) INVESTIGATION OF GAS IONIZATION PHENOMENON AT OPTICAL AND IR FREQUENCIES. Interim Progress Report No. 2, August–December 1964. VanAllen, L. C.; Wynant, R.; Phelps, A. D.; Gaver, D. P.; Marshall, J. A. (Westinghouse Defense and Space Center, Baltimore, Md. Surface Div.). Feb. 1965. Contract AF30(602)-3332. 88p. (RADC-TR-64-568) $3.00(CFSTI).

The status of the work on ruby laser induced gas ionization is summarized. Experimental measurements of the focused spot diameter, breakdown emission, ionization times, and nonattenuation ionization are presented. The theoretical study results obtained to date in the areas of nonlinear ionization initiation and the extension of the microwave breakdown theory are discussed. (auth)

34770 (AD-612806) ELECTRON RETARDING POTENTIAL MEASUREMENTS ON CO_2, N_2O AND NO_2. Schoen, Richard I. (Boeing Scientific Research Labs., Seattle, Wash.). Feb. 1965. 31p. (D1-82-0406) $2.00 (CFSTI).

Electron retarding potential curves were obtained for the gases CO_2, N_2O and NO_2 from which estimates were made of several appearance potentials which lie in the ionization continua of each of the gases. Evidence is present in the case of CO_2 of autoionization and in the cases of NO_2 and N_2O of dissociative ionization. Refinement of the method to the point at which clear evidence of vibrational excitation can be seen is needed. (auth)

34771 (AD-613049) APPLIED RESEARCH INVESTIGATION OF ELECTRIC FIELD SOURCES VIA SOLID IONS MATRIX. [Period Covered]: July 1964–March 1965. Elder, Robert F. (National Water Lift Co., Grand Rapids, Mich.). Contract AF33(615)-2041. 19p. (AFAPL-TR-65-5) $1.00(CFSTI).

The results are presented of a study program involving the generation of a stored electric field, analogous to a permanent magnet field, using dielectric materials bombarded with low-energy beta particles. Methods for achieving the volumetric distribution of such particles in a solid dielectric material (quartz) were investigated utilizing the Van de Graaff generator principle. The technique utilized combinations of high-voltage accelerators and high-vacuum systems. (auth)

34772 (ANL-6963) ELECTRICAL END LOSSES IN AN MHD CHANNEL OF LINEARLY VARIABLE CROSS SECTION. Moszynski, Jerzy R. (Argonne National Lab., Ill.). Mar. 1965. Contract W-31-109-eng-38. 25p. Dep.; $1.00(cy), 1(mn) CFSTI.

The electrical losses due to end-shorting of electrodes in an MHD channel of linearly variable cross section have been calculated, under the assumption of large Reynolds number and small magnetic Reynolds number. It is shown that a simplified calculation procedure yields exact results and, further, that an approximate procedure, based on the results for a constant-area channel, provides satisfactory accuracy for channels of small included angle and/or relatively large aspect ratio. (auth)

34773 (CERN-65-20) THE ELEMENTARY THEORY OF LANDAU DAMPING. Hereward, H. G. (European Organization for Nuclear Research, Geneva (Switzerland)). May 28, 1965. 45p. Dep.(mn).

The theory of a simple form of Landau damping—the dissipation process described by Buneman—is outlined and used to illustrate subsequent discussions. The appearance of infinite amplitudes in the summation spectra of a system of resonators is discussed, and possible physical reasons why resonators with infinitely large amplitudes are not found in practice are considered, including the finite time of existence of the simple harmonic driving force and the limitations of the linear approximation to the equation of motion. Stabilization by Landau damping is discussed. (M.J.T.)

34774 (PPAD-524-E) FORTRAN COMPUTER PROGRAMMES FOR MAGNETIC FIELDS FROM AXIALLY SYMMETRIC AIR CORE SOLENOIDS. Henry, G. R.; Schrank, G. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Aug. 1964. Contract AT(30-1)-2137. 21p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Computer programs are presented for computing the off-axis magnetic field values of a current-carrying coil and for determining the coil configuration that will produce a specified magnetic field over a given volume of space. The programs are written in IBM 650 FORTRAN and are applicable to any system of coils with arbitrary cross-sectional areas and current densities so long as all coils are coaxial and all current densities have only an azimuthal component. (M.J.T.)

34775 (FTD-MT-64-284) JOURNAL OF APPLIED MECHANICS AND TECHNICAL PHYSICS (COLLECTION OF ARTICLES). Translation of "Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki," No. 1, (Jan.-Feb. 1964), Izdatel'stvo "Nauka." 234p. CFSTI.

Twenty-five articles are included. Separate abstracts were prepared for two. Four articles were previously abstracted for NSA; see abstracts 18: 26148, 26766, 26767, and 26768. (M.J.T.)

For abstracts of individual papers see: 35529 and 35567.

34776 RELATIVISTIC STUDY OF VISCOUS AND CHARGED FLUIDS. Pichon, Guy (Universite, Paris). Ann. Inst. Henri Poincare, Sect. A, 2: 21-85(1965). (In French)

A treatment of fluid mechanics in general theory of relativity is presented. The form of the energy-momentum 4 tensor is determined and viscosity, electromagnetic field and thermal conduction are introduced. The equations of viscous thermodynamic fluids are studied and more particularly the Cauchy's problem and the equations of rotational. Charged fluids are discussed. The velocity of sound in such a medium is determined and the singular field is defined. Finally, with aid of tensor distribution the equations which are satisfied by the discontinuities of the electromagnetic field across a submanifold of the space-time are established. (auth)

34777 OPTIMUM SEEDING OF HELIUM WITH CESIUM. Sodha, M. S.; Kaw, P. K.; Chadha, S. (Indian Inst. of Tech., New Delhi). Brit. J. Appl. Phys., 16: 833-6(June 1965).

In this communication the optimum seeding of helium with cesium, to obtain maximum conductivity at various electric fields (and electron temperatures T_e) has been investigated using the latest data on dependence of electron-collision cross sections on electron velocity. An interesting result is the fact that the optimum ratio α of the number of cesium to helium atoms is given by $\alpha = 3.6 \times 10^{-4}\ T_e^{3/2}$ where T_e is expressed in °K. A relation between the electron temperature and the applied electric field has also been obtained for the interesting case of optimum seeding. (auth)

34778 MATHEMATICAL STUDY OF THE EQUATIONS OF RELATIVISTIC MAGNETOHYDRODYNAMICS. Lichnerowicz, Andre. Compt. Rend., 260: 4449-53(Apr. 26, 1965). (In French)

The problem of Cauchy concerning the system of magnetohydrodynamics is reduced to the problem of Cauchy relative to a system with principal diagonal part not strictly hyperbolic in the Leray sense. A local theorem of existence and corresponding unicity is given. (tr-auth)

34779 THE ORTHO-PARA EQUILIBRIUM OF H_2, D_2, AND T_2. Frauenfelder, R. (Eidgenoessische Technische Hochschule, Zurich); Heinrich, F.; Olin, J. B. Helv. Phys. Acta, 38: 279-98(May 15, 1965). (In German)

The thermodynamic ortho-para-equilibria in the H_2, D_2, and T_2 systems were determined in the temperature range from 20 to 250°K with an accuracy of 0.4, 0.1, and 0.6% paraconcentration respectively. In order to produce equilibrium mixtures of gases corresponding to the theory by Dennison the hydrogen isotopes were adsorbed on CeO_2. After ortho-para-transition had taken place a small sample of the adsorbed gas was isothermally desorbed and the para content determined through a comparative measurement of thermal conductivity. The thermal conductivity cells were calibrated using a mixture of normal gas and gas which had been equilibrated at 20°K. These cells were operated at liquid nitrogen temperature. They contained thermistors with a large temperature coefficient permitting 0.01% relative changes in thermal conductivity to be determined reproducibly. The maximum deviation between measured equilibrium concentrations and those computed according to the theory by Dennison amounted to 1.6 and 0.6% para concentration for H_2 and D_2 respectively, but to 6.0%, for T_2. The ionizing effect of tritium β activity is the probable cause for this difference in behavior. Further consequences of the β radiation are a p → o reversion of T_2 in the gas phase at room temperatures ($T_{\frac{1}{2}} \sim 100$ min) and a o → p conversion in solid T_2 at 4.3°K [$T_{\frac{1}{2}} = (90 \pm 10)$ min]. (auth)

34780 OFF DIAGONAL LONG-RANGE ORDER AND GENERALIZED BOSE CONDENSATION. Girardeau, M. D. (Univ. of Oregon, Eugene). J. Math. Phys. (N. Y.), 6: 1083-98(July 1965).

It is shown for boson systems with periodic boundary conditions that the existence of generalized Bose condensation, of which the simple type typified by the ideal Bose gas is a special case, is equivalent to the existence of off-diagonal long-range order (ODLRO) in the single-particle density matrix ρ_1 provided that the two noncommuting limits involved in the criterion for ODLRO are taken in the proper order: first size of system → ∞, then interparticle separation → ∞. It is shown by means of an example that certain assumptions concerning the behavior of the single-particle momentum distribution function involved in proving this equivalence are actually satisfied in thermal equilibrium for some dynamical models. The analysis is generalized to box-enclosure boundary conditions by an extension of an argument due to Schafroth, according to which box-enclosure conditions are equivalent to homogeneous Neumann conditions except for a thermodynamically negligible surface effect, provided that one second-quantizes with respect to Hartree–Fock orbitals rather than free-particle orbitals. A general criterion for generalized Bose condensation in terms of eigenvalues of ρ_1 is proposed. On the basis of the behavior of soluble models it is conjectured that for a boson system in thermal equilibrium subject to arbitrary boundary conditions, the existence of such Bose condensation is equivalent to the existence of ODLRO in ρ_1. The two-particle density matrix ρ_2 is discussed briefly. By means of a simplified model it is shown that for a Bose system generalized condensation implies large eigenvalues of ρ_2 and ODLRO of ρ_2, just as for ρ_1. It is pointed out that the question of the existence or nonexistence of generalized Boze condensation of fermion pairs ought to be investigated. (auth)

34781 ELECTROGASDYNAMICS. Hasimoto, Hidenori; Kuwabara, Sinzi (Johns Hopkins Univ., Baltimore and Cornell Univ., Ithaca, N. Y.). J. Phys. Soc. Japan, 20: 859-68(May 1965).

Gasdynamic equations for an electrically charged gas are simplified on the basis of quasi-static approximation. Electrogasstatics of the charged gas on a sinusoidal insulator wall is studied for various external electric fields and polytropic indices. Irrotational steady two-dimensional circulatory flow is also studied with special reference to the diameter of the vacuum core, which is shown to be increased in general by the electrostatic repulsion. (auth)

34782 EXTRACTION OF NEGATIVE HYDROGEN IONS FROM A DUOPLASMATRON ION SOURCE. Collins, L. E.; Gobbett, R. H. (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 35: 277-82(Aug. 1965).

The direct extraction of negative hydrogen ions from a duoplasmatron ion source was investigated. It was found that the output increased as the point of extraction was moved towards the edge of the arc. The dependence on source conditions was studied, and 80 μamp of H_1^- were obtained with a total source electron load of 2 to 4 mamp. The processes of H_1^- formation and the effect of the source magnetic field on the electron beam accompanying the ions are discussed. The energy spread of the negative ions was measured to be 10 to 20 ev. (auth)

34783 MODEL OF A RAPID FIELD INVERTER. Pflumm, H. (CERN, Geneva). Nucl. Instr. Methods, 35: 317-20(Aug. 1965).

A model circuit of a rapid field inverter for beam transport bending magnets is described. This circuit consists of silicon-controlled rectifiers as high current or voltage switching elements. By means of energy storage and compensation of losses in a parallel circuit consisting of the inductance of the bending magnet with a condenser, the current of the bending magnet can be reversed and brought back to its previous d-c current value within a few msec only. (auth)

34784 ABSTRACT PHYSICS. Atkin, R. H. (Univ. of Essex, Eng.). Nuovo Cimento (10), 38: 496-517(July 1, 1965).

Modern algebraic concepts are shown to be compatible with models in physics. These abstract ideas are then used to frame a definition of an abstract physics; the definition is then used to analyse the greater part of ordinary physics and to throw light on various theories and methods of finding natural laws. In all, nine examples of the abstract physics are produced, viz., Ph I (a geometry of space) to Ph IX (electromagnetism), in each of which the significance of the (1–1) correspondence is brought out, as well as the idea of the generating elements. Among the latter, base-element is singled out for its special role, and it is shown that observation of such an element contains a built-in natural law. A final result is obtained in Ph IX of an abstract conservation of energy in the algebra $\mathcal{CP}^2$. The analysis stops short, in each case, of considering field theories. (auth)

34785 ON THE STABILITY OF THE ELECTRON GAS GROUND STATE. Amusia, M. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Letters, 16: 254-5(June 1, 1965).

Previous arguments that the ground state of a degenerate electron gas is of the Overhauser type, that is, its density periodically changes in space, are corrected. It is recognized that in the high density limit the kinetic energy is much larger than the potential energy of interaction of two electrons. This is shown to imply that the movement of electrons in the high density limit had to be insignificantly disturbed by their interaction and the space-homogeneity ground state had to be stable. (M.O.W.)

34786 ON THE SPIN SUSCEPTIBILITY OF LANDAU'S FERMI LIQUID. De Graaf, A. M.; Luzzi, R. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Phys. Letters, 16: 256-7(June 1, 1965).

It is shown that the spin density in an interacting electron gas, induced by space dependent magnetic fields can be obtained from Landau's theory of the Fermi liquid. A brief discussion of susceptibility is included. (M.O.W.)

34787 ONE-DIMENSIONAL, MANY-BODY CALCULATION WITH A CORRELATED GAUSSIAN WAVE FUNCTION. Koehler, T. R. (IBM Research Lab., San Jose, Calif.). Phys. Rev., 139: 1097-1100(Aug. 16, 1965).

A two-parameter many-body correlated Gaussian wave function is used to calculate the expectation value of the hamiltonian for N one-dimensional particles interacting through the one-dimensional analog of an atomic potential. Using a potential equal to four times the Slater-Kirkwood

He-He potential, the optimum average interparticle separation, the ground-state energy, and the velocity of sound of the system as a function of particle mass are calculated. It is found that the correlated Gaussian always gives an improvement in energy compared with an uncorrelated Gaussian. (auth)

34788 MICROSCOPIC THEORY OF BROWNIAN MOTION IN AN OSCILLATING FIELD; CONNECTION WITH MACROSCOPIC THEORY. Lebowitz, J. L. (Yeshiva Univ., New York); Resibois, P. Phys. Rev., 139: 1101-11 (Aug. 16, 1965).

Recently, Lebowitz and Rubin, and Résibois and Davis, showed that the Fokker-Planck equation for the distribution function of a Brownian particle (B particle) of mass M, in a fluid of particles of mass m, may be derived directly from the Liouville equation for the joint distribution of fluid and B particle. It is the lowest order term in a $(m/M)^{\frac{1}{2}}$ expansion of the effect of the fluid on the distribution of the B particle. These authors studied in particular the steady-state distribution function of B particles acted on by a small constant external field E, which results from a balance between the effects of the driving force and those of the fluid. These studies are extended to the case where the B particle is acted on by a time-dependent field $Ee^{i\omega t}$. It is found that the effect of the fluid on the distribution function of the B particle is again given, to lowest order in $(m/M)^{\frac{1}{2}}$, by a Fokker-Planck term, albeit one with a frequency-dependent friction constant, $M\zeta(\omega) \sim \int_0^\infty \langle F(0) \cdot F(t)\rangle e^{i\omega t}dt$. Here F is the microscopic, N-body force acting on a stationary B particle and the average is over the equilibrium distribution function of the fluid in the presence of this fixed B particle. We further show that $-M\zeta(\omega)V_\theta e^{i\omega t}$ is equal to the force acting on a B particle moving through the fluid with a prescribed small velocity $V_\theta e^{i\omega t}$. Under appropriate circumstances this latter force may be computed from kinetic theory or from hydrodynamics. Thus there is complete agreement between the microscopic theory and that obtained from stochastic considerations. The relation between the different formalisms used by Lebowitz and Rubin and by Résibois and Davis is clarified. (auth)

34789 ENERGY SPECTRUM OF A SIMPLE BOSE-EINSTEIN MODEL. Friedman, Marvin H. (Northeastern Univ., Boston). Phys. Rev., 139: 1111-14(Aug. 16, 1965).

A soluble model of a Bose-Einstein system is examined, in which the interaction energy between particles is attractive as the momentum approaches zero. The model is based on one proposed by Bassichis and Foldy. (auth)

34790 STATISTICAL MECHANICS OF IRREVERSIBLE PROCESSES AND THE PRINCIPLE OF MINIMUM ENTROPY PRODUCTION. Currin, J. D. (Univ. of Colorado, Boulder). Phys. Rev., 139: 1156-8(Aug. 16, 1965).

The transport properties of a system of N weakly interacting subsystems are derived using as the basic statistical assumption a principle of minimum entropy production. This replaces the assumption of "local equilibrium" where each subsystem is assumed to be described by a canonical distribution at the initial time. (auth)

34791 CONCERNING THE APPLICATION OF GENERAL VARIATIONAL PRINCIPLES TO THE RELATIVISTIC MECHANICS OF AN IDEAL FLUID. Gurovich, T. Ts.; Stanyukovich, K. P. Prikl. Mat. i Mekhan., 29: 18-25 (1965).

An equation is derived for the motion of a relativistic medium in the special theory of relativity and for spherically symmetrical motion in a Schwarzschild gravitational field. The equation is also convenient to use in the absence of a gravitational field, if the calculations are carried out in an arbitrary curvilinear coordinate system. No difficulties are encountered in the solution of the equations describing the motion of gas by the method of characteristics in a Schwarzschild field. (auth)

34792 SOLUTION OF VARIATIONAL PROBLEMS IN ONE-DIMENSIONAL MAGNETOHYDRODYNAMICS. Kraiko, A. N.; Slobodkina, F. A. Prikl. Mat. i Mekhan., 29: 322-33(1965). (In Russian)

In order to calculate the one-dimensional flow of a conducting medium at low magnetic Reynolds numbers, the shape of the channel and the electric and magnetic field intensity must be known. In such calculations of the flow within a channel of a magnetohydrodynamic generator, special attention must be devoted to cases in which the characteristics of the channel and of the electromagnetic field assume maximum values, e.g., maximum power, minimum of losses, etc. The problem may be solved by means of the variational computation method. Previous attempts to solve such problems were either unsuccessful or their validity was limited narrowly to specific cases, such as isothermic flow. The cases considered include one in which the medium was nonviscous and non-heat-conducting, operating at a given magnetic field in a flat channel and possessing a certain electric conductivity and another, in which the electric conductivity was constant. (TTT)

34793 RETARDING-FIELD ANALYZERS FOR THE MEASUREMENT OF AXIAL-VELOCITY DISTRIBUTIONS IN ELECTRON BEAMS. Caulton, Martin (RCA, Princeton, N. J.). RCA Rev., 26: 217-41(June 1965).

Retarding-field analyzers for the measurement of axial-energy distributions in magnetically confined electron beams with energy spreads in the range of 1 to 50 v were studied. A retarding-field analyzer was developed incorporating a filter lens, in which the analyzing electrode does not intercept or collect the retarding current. This system has the advantages of ease of measurement, simplicity, and freedom from secondary-electron effects and surface charging. Lens and ion distortion effects were minor, and the potential depression due to space charge could be accounted for. Measurement capabilities were demonstrated on beams with a variety of velocity spreads. (auth)

34794 SIMPLIFIED WEDGE MAGNET DESIGN INCLUDING FRINGE EFFECTS. Godlove, Terry F.; Bendel, Warren L. (Naval Research Lab., Washington, D. C.). Rev. Sci. Instr., 36: 909-14(July 1965).

The concept of replacing each magnet edge by a suitably located thin lens is used to develop a set of design formulas for the transverse focusing properties of uniform-field deflecting magnets. A brief comparison is given to recent work of Enge, who showed that the thin lens concept is a valid first order approximation. The formulas are applied to several examples, including a double focusing magnet with arbitrary deflection angle and ratio of gap to radius of curvature. Finally the method is used to study the transverse acceptance angle of a certain class of "beam dump" magnets. (auth)

34795 EFFICIENCY OF MAGNETIC CHANNELS. Uccelli, Fabio (Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Rev. Sci. Instr., 36: 975-8(July 1965).

A quantitative method for determining the efficiency of magnetic channels for charged particles is described. Formulas for evaluating the dispersion and the chromatic aberration of a magnetic channel in the Gauss approximation are given. (auth)

34796 GENERAL PURPOSE GAS TARGET SYSTEM. Mollenauer, James F. (Brookhaven National Lab., Upton, N. Y. and Bell Telephone Labs., Inc., Murray Hill, N. J.). Rev. Sci. Instr., 36: 1044(July 1965).

A gas cell for experiments of nuclear scattering, dealing with light targets, was developed which meets the criteria for gas cells and performs successfully. It is expected that the design will not necessitate appreciable modification of existing scattering chamber designs. (J.F.P.)

34797 CRYSTAL ORIENTER FOR ION BOMBARDMENT EXPERIMENTS. Widmer, A. E. (North American Aviation Science Center, Thousand Oaks, Calif.). Rev. Sci. Instr., 36: 1054(July 1965).

Due to the importance of crystal structure in a target being bombarded, target crystal direction must be aligned accurately. A simple crystal mounting device is described which is easily oriented to the ion beam and is appropriate

to use with relatively simple ion sources such as contact ionizers or Penning cells. (J.F.P.)

34798 DOUBLE FOCUSING BY A HOMOGENEOUS-SECTOR MAGNETIC FIELD WITH RECTILINEAR BOUNDARIES. Saulit, V. R. Vestn. Leningr. Univ., No. 4, Ser. Fiz. I Khim., No. 1, 49-66(1965). (In Russian)

The exact conditions of double focusing by a sector-shaped magnetic field whose boundaries are straight lines are obtained on the assumption that the fringing fields on the medium plane are functions of a single cartesian coordinate. (auth)

34799 ON THE PLUNGER PROBLEM IN MAGNETOGASDYNAMICS. Baush, G. Vestn. Leningr. Univ., No. 7. Ser. Fiz. i Khim., No. 2, 95-105(1965). (In Russian)

One dimensional non-stationary motion of electric conducting gas in transversal magnetic field produced by the piston movement is investigated. The problem is solved by linearization around the flow produced by the piston motion with constant velocity. The low of piston motion is close to linear. (auth)

34800 TRANSFORMATION FROM POINT AND OTHER VERY SIMPLE SOURCE SHAPES TO A CYLINDER. Popov, V. I. pp 8-14 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

The transformations from one geometrical shape of radiation source to another (from a point, line, and disk to a cylinder) were surveyed on the basis of calculations using the computer Strela. The transformations permit the dosage rate produced by one shape source to be determined from experimental or calculated data on the dose rate from a source of another shape. The results are presented in the form of nomograms for practical use. (M.J.T.)

34801 ION BOMBARDMENT CAMERA FOR CRYSTAL ORIENTATION DETERMINATION. Cunningham, Robert L.; Grant, Alexander V.; Ng-Yelim, Joyce; Gow, Kenelm V. (to Minister of Mines and Technical Surveys). U. S. Patent 3,180,987. Apr. 27, 1965. Filed June 20, 1963.

An apparatus is described for determination of the orientation of crystal lattices by bombarding a sample in vacuum with accelerated ions under such conditions that atoms are ejected from the crystal in known crystallographic directions because of momentum transfer along certain directions in the crystal lattice. By collection of the ejected atoms on either flat or hemispherical collector plates, the ejection directions and, therefore, the directions of the crystal lattice are directly recorded. (A.G.W.)

Accelerators

Refer also to abstract 35564.

34802 (AD-610190) A LINEAR ELECTRON ACCELERATOR FOR SUBMILLIMETER WAVE GENERATION. Miller, R. H. (Stanford Univ., Calif. Microwave Lab.). Oct. 1964. Contract Nonr 225(48). 130p. (ML-1244). $4.00(CFSTI).

The use of a relativistic beam of electrons for the generation of submillimeter waves in large interaction structures was investigated as a possible alternative to the scaling of conventional microwave generators to the extremely small dimensions required. The design of an X-band linear accelerator for production of a beam having high harmonic current content is discussed, and various methods of achieving good bunching are considered. A small angle theory of bunching in a distributed buncher is developed and used as a guide in the design of the buncher section of the accelerator. A new microwave measurement technique for measuring field strength and phase in nonresonant structures was used to determine the electric properties of the buncher. The effect of auxiliary equipment on the operation of the distributed buncher and accelerator is evaluated. Experimental results from the use of the accelerator with a magnetic undulator are presented. Radiation is detected in the range from the sixth harmonic to the eightieth harmonic (wavelength equals 0.4 millimeter) of the accelerator frequency. Peak powers generated are of the order of 150 mw at 5 mm, 40 mw at 1 mm, and ¼ mw at 0.4 mm. The dependence of the radiation on magnetic field strength, magnet spacing, interaction length, and waveguide size is in excellent agreement with theory. (auth)

34803 (CERN-65-18) A METHOD OF INCREASING THE SPACE-CHARGE LIMIT OF THE CERN PROTON SYNCHROTRON. Soerenssen, Aimar (European Organization for Nuclear Research, Geneva (Switzerland)). May 20, 1965. 12p. Dep.(mn).

The problem of space-charge forces, which depress the effective Q-values (the number of betatron oscillation periods per revolution) of particles with different synchrotron oscillation amplitudes by different amounts, is discussed. The use of dynamic electric or magnetic quadruple lenses, which are given an excitation proportional to the instantaneous line-charge density inside the quadrupole, thus treating different particles differently, is considered for defocusing compensation. Calculations are made of the number of quadrupoles, focusing power, and excitation currents needed for a practical system. The technical problem of making a precise compensation of the space-charge force for all parts of each bunch is discussed. The basic limitation of the system, that the space-charge force and the quadrupole compensating force are directed with respect to different centers, is explained. (M.J.T.)

34804 (CERN-65-23) MEASUREMENTS ON A HIGH-GRADIENT ACCELERATING TUBE MODEL — INVESTIGATION OF THE PROPERTIES OF TITANIUM ELECTRODES. Huguenin, J.; Dubois, R. (European Organization for Nuclear Research, Geneva (Switzerland)). June 10, 1965. 32p. Dep.(mn).

A 540-kv high-gradient accelerating tube for protons is being developed in CERN. Model tests were performed to investigate the effects of electrode material and geometries. D-c breakdown tests across gaps ranging from 2.5 to 9.3 cm showed the excellent properties of titanium as electrode material. At 2.5 cm and 2.10^{-6} mm Hg, the maximum cathode field was greater than 200 kv/cm and the maximum mean field equal to 190 kv/cm. Practically no current or x rays could be observed between sparks. In accordance with the results of these experiments, the electrodes of the CERN high-gradient tube were fabricated in titanium. (auth)

34805 (JINR-P-2119) PRIBLIZHENNYI METOD RASCHETA FOKUSIROVKI CHASTITS SISTEMOI MAGNITNYKH LINZ. (Approximate Method for Calculating the Particle Focusing by a System of Magnetic Lenses). Maikov, E. V.; Miller, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965 8p. Dep.(mn).

The expansion of the matrix describing the doublet and triplet of the quadrupole magnetic lenses is obtained. For a stigmatic source and image this expansion allows the approximate values of the field gradients providing the desired transformation of the beam to be obtained by solving a quadratic equation. (auth)

34806 (JINR-P-2165) FORMIROVANIE MAGNITNOGO POLYA SPIRAL'NOGO TSIKLOTRONA S POMOSHCH'YU TOKOV. (The Production of the Magnetic Field of the Spiral Cyclotron by Means of Currents). Vorozhtsov, S. B.; Zaplatin, N. L.; Kropin, A. A.; Rybalko, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 16p. Dep.(mn).

The production of the magnetic field of the spiral cyclotron using the current windings is described. The characteristics of the beam of deuterons accelerated to 13.5 Mev are presented. A possibility of converting the cyclotron for the acceleration of protons is considered. (auth)

34807 (LAL-1124) INFLUENCE DU RAYONNEMENT EN PRESENCE DE COUPLAGE DANS LES ACCELERA-

TEURS CIRCULAIRES. APPLICATION A L'ANNEAU "A.d.A". (Influence of Radiation in Presence of Coupling in Circular Accelerators. Application to the "A.d.A." Ring). Gratreau, P. (Laboratoire de l'Accelerateur Linealre, Univ. de Paris, Orsay (France)). Dec. 1964. 57p. Dep.(mn).

The general problem of the damping of betatron oscillations in the presence of coupling was considered, and the dimensions necessary for beam equilibrium were deduced. The coefficients of damping were calculated by the method of variation of canonical constants. The formulas were expressed as a function of Floquet factors. These are characteristics of the accelerator and knowledge of them makes possible a numerical calculation. An example of the numerical calculation for AdA was given. (J.S.R.)

34808 (LNF-64/64) CONSIDERAZIONI SUL CHROMATISMO DI UN CANALE MAGNETICO RETTILINEO. (Considerations on the Chromatism of a Rectilinear Magnetic Channel). Note No. 268. Bassetti, M. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Dec. 16, 1964. 13p. Dep.(mn).

A perturbation study is made of the energy exchange of the particle passing along a rectilinear channel and of the current feeding the quadrupoles. (J.S.R.)

34809 (LNF-64/68) IL DEFLETTORE DI ADONE: STUDI E PROGETTO. (The Adone Deflector: Studies and Design). Note No. 275. Massarotti, A.; Puglisi, M.; Tazzioli, F. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Dec. 22, 1964. 33p. Dep.(mn).

The characteristics of a deflector with electric and magnetic field and a deflector with a magnetic field are described and compared. An analysis is made of the functioning of the magnetic field deflector, and the profile of the conductors is derived. The design of the deflector selected and measurements made on a model are recorded. The dimensions of the complete plant and its characteristics are given. (J.S.R.)

34810 (LNF-65/5) RENDIMENTO DI INIEZIONE IN UN ANELLO DI ACCUMULAZIONE. (Injection Yield in a Storage Ring). Note No. 271. Mango, L. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Feb. 19, 1965. 18p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

The results of a series of calculations on the injection yield for the Adone storage ring are reported. Two distinct methods of injection — injection with pulse deflector and injection with divided deflector — are considered. (J.S.R.)

34811 (NP-15043) USTOICHIVOST' CHASTICHNO KOMPENSIROVANNOGO ELEKTRONNOGO PUCHKA. (Stability of a Partially Compensated Electron Beam). Chirikov, B. V. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). 1964. 23p. Dep.(mn).

Conditions for the sinuous (bending) instability of a partially neutralized electron beam are considered. It is shown that there is always a domain of strong instability with relatively large increment for a continuous spectrum of perturbation wave vectors. In the case of a line spectrum (for instance due to finite beam length in accelerators) the instability takes place only for beam current greater than a certain critical value. Radiation and Landau dampings do not suppress the instability. A weak dissipative instability due to radiation damping was discovered. In some cases Landau damping suppresses this instability; however in other cases it can intensify it. The investigation was carried out for a beam model having the shape of two threads (electron and ion) of fixed dimensions and uniform densities. (auth)

34812 (RT/FI(64)-24) L'ACCELERATORE LINEARE DI ELETTRONI A MICROONDE: ASPETTI TECNOLOGICI DELLO SVILUPPO. (Microwave Electron Linear Accelerator: Aspects of Technological Development). Rosatelli, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov. 1964. 16p. Dep.(mn).

A review of the major technological problems concerning microwave electron linear accelerator is carried out in order to complete previous work done on high current intensity machines. The questions considered are: sources of r-f power, cooling systems, construction of the accelerating waveguide and electron gun; the possibility of using this type of machine for medico-biological and industrial purposes is also considered. (auth)

34813 (SLAC-39) MAGNETIC FIELD MEASUREMENT AND SPECTROSCOPY IN MULTIPOLE FIELDS. Cobb, J. K.; Muray, J. J. (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Feb. 1965. Contract AT(04-3)-400. 83p. Dep.; $2.00(cy), 2(mn) CFSTI.

Magnetic field measurements in multipole magnetic fields, which are used to measure magnetic field parameters in the strong-focusing lenses for the Stanford two-mile linear accelerator, are reviewed. Specifically, the theory and the measurement processes used to determine such important parameters as the magnetic center in multipoles, the length of the gradient fields, and the harmonic content in strong-focusing lenses will be described. The results of these accurate measurements are related to the optical parameters of the multipole lenses. A short summary of the properties and field distribution of these lenses is given. (auth)

34814 PARTICLE ACCELERATORS IN PAST AND FUTURE. Schaffer, G. (Deutsche Elektronen-Synchrotron, Hamburg). Atompraxis, 11: 253-63(May 1965). (In German)

Stimulated by the demands of nuclear research, the energy of particle accelerators has grown from 1 million to more than 30 billion electron volts during the past 35 years. Today the results of technical studies carried out at several high-energy physics laboratories already show the feasibility of accelerators in the 300 to 1000 Bev range with orbit diameters of several miles. This development is based on the principles of phase-stable radiofrequency acceleration and strong beam focusing. The most important types of accelerators and their historical development are briefly described. (auth)

34815 ESTIMATE OF THE SPECTRUM OF IONIZING SOLAR RADIATION DURING THE FLARE OF AUGUST 22, 1958, ACCORDING TO VERTICAL SOUNDINGS OF THE IONOSPHERE. Odintsova, I. N. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR) (English Transl.), 4: 805-10(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1035-(1964).

From a study of N(h) profiles at heights from 100 to 320 km, it was found that a considerable increase in electron concentration at the levels of the F_2 and E layers of the ionosphere took place during the flare. No noticeable increase in electron concentration was found at heights from 120 to 220 km. The ionization rate at heights from 100 to 320 km is computed for the time of the maximum of the effect. The data obtained are used to estimate the intensity spectrum of short-wave solar radiation <1000 Å at the time of the flare. (auth)

34816 ASYMMETRICAL QUADRUPOLE LENSES IN A BEAM TRANSPORT SYSTEM. Koltay, E.; Szabo, Gy. (Inst. of Nuclear Research, Debrecen, Hungary). Nucl. Instr. Methods, 35: 88-92(1965).

The lens characteristics of quadrupole singlets and doublets with asymmetrically fed poles are given using the matrix formalism of the electron optics. (auth)

34817 THE DACCA VAN DE GRAAFF. Hussain, M. Emdad. Nucleus (Lahore), 2: No. 1, 27-9(Jan.-Mar. 1965).

The characteristics and operating systematics of the Dacca 3 Mev Van de Graaff accelerator are described. (L.B.S.)

34818 NOTE ON LARGE PROTON SYNCHROTRONS. Riddiford, L. (Univ. of Birmingham, Eng.). Phys. Letters, 17: 160-2(July 1, 1965).

A comparison is made, partly on the basis of existing machines, of the currents that should be obtained by the

use of large proton linear accelerators, or constant or alternating gradient proton synchrotrons, when the large synchrotrons are operated at full energy, and when they are used to provide an intense beam at the lower energy of an existing machine. The possibility of beam stacking, radially using a linac ejected beam from an alternating gradient booster, prior to acceleration, is considered. (J.F.P.)

34819 PRODUCTION OF SHORT PULSES OF ION CURRENT IN ELECTROSTATIC ACCELERATORS. Vorotnikov, P. E. (Inst. of Nuclear Energy, Moscow). Pribory i Tekhn. Eksperim., No. 3, 27-33(May-June 1965). (In Russian)

A calculation of the phase focusing of ions of an electrostatic accelerator is carried out. It is shown that current pulses of H^+ and D^+ of about 1.5 mamp, with length about 3×10^{-9} sec, and nonmonoenergetic by about 2×10^{-4} can be obtained in the accelerator output, using the ordinary low-power ion sources and imposing a longitudinal alternating electric field on the ions immediately after their emission from the source. (tr-auth)

34820 STABILITY PARAMETERS OF ACCELERATED BEAM IN A MICROTRON. Kanter, B. Z. Pribory i Tekhn. Eksperim., No. 3, 34-8(May-June 1965). (In Russian)

A calculation is given of the dependence of the equilibrium phase in a microtron on the value of the relative supply voltage. The calculation and results of measurements indicate that the basic cause of variations in the parameters of the accelerated-electron beam is the displacement of the equilibrium phase due to instability of the anode voltage of the magnetron, which should be <0.1%. It is shown that the effect of the instability can be reduced to a minimum by means of a choice of parameters of the high-frequency circuit and magnetron. (tr-auth)

33821 SINGLE-TURN MAGNETIC INFLECTOR. Kazanskii, L. N.; Troyanov, E. F. (Inst. of Physics, Moscow). Pribory i Tekhn. Eksperim., No. 3, 39-42 (May-June 1965). (In Russian)

A description is given of the principle of operation and the apparatus of a single-turn magnetic inflector which produces a pulsed magnetic field that quenches the radial betatron oscillations of the injected particles. The inflector consists of a double-loop frame, supplied by current pulses with amplitude from 10 to 120 amp, length 50 nsec, and wave fronts of 15 nsec. The inflector was used on the electron ring phasatron. (tr-auth)

34822 SPARK SOURCE IN A STRONG-CURRENT ELECTRON INJECTOR. Suladze, K. V.; Plyutto, A. A.; Iremashvili, D. V. (Inst. of Physics and Tech., Lukhumi, USSR). Pribory i Tekhn. Eksperim., No. 3, 46-7(May-June 1965). (In Russian)

Some results are reported of tests of a spark source in an electron injector capable of producing a pulsed focused electron beam with current of 10 amp for pulse length of the drawing-off voltage of 5×10^{-8} sec and amplitude up to 10^6 v. (tr-auth)

34823 ON ONE OF THE POSSIBILITIES FOR SEPARATING HIGH-ENERGY ELECTRONS IN π-MESON BEAMS. Pantuev, V. S.; Khachaturyan, M. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 3, 51-2(May-June 1965). (In Russian)

A study was made on the possibility of using high-energy electrons, present as impurities in π-meson beams, for calibrating total absorption Cherenkov counters. On the basis of data obtained from experiment, the fraction of electrons in a beam of π^--mesons with 4 Bev/c momentum was determined. (tr-auth)

34824 BETATRON VACUUM CHAMBER FOR EXPERIMENTAL STUDIES. Vokalek, V. (Inst. of Plasma Physics, Czechoslovak Academy of Sciences, Prague). Pribory i Tekhn. Eksperim., No. 3, 173-5(May-June 1965). (In Russian)

The construction, measuring apparatus, and characteristics of the sealed-off vacuum system of a 15-Mev betatron with Ti pump, which provides a vacuum in the chamber not worse than 10^{-8} torr, are described. The advantages of operation with the given chamber over other methods (chamber with continuous evacuation, collapsible chamber) are explained. (tr-auth)

34825 SUPPLY OF ALTERNATING POWER FOR ELECTRON CYCLIC ACCELERATOR INFLECTOR. Ekivin, V. V. (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 3, 216-17(May-June 1965). (In Russian)

A device for supplying the alternating potential for the inflector plates of the injecting apparatus of a 35-Mev betatron, simplifying the supply of the installation and increasing the radiation stability, is described. (tr-auth)

34826 RESONANT MAGNET NETWORK AND POWER SUPPLY FOR THE 4 Gev ELECTRON SYNCHROTRON NINA. Fox, J. A. Proc. Inst. Elec. Engrs., (London). 112: 1107-26(June 1965).

The resonant magnet network and power supplies of the 4 Bev electron synchrotron Nina, under construction at the Daresbury Nuclear Physics Laboratory, Cheshire, are described. The requirements of high accuracy and uniformity in the magnetic guide field pose special problems in magnet-network arrangements, excitation methods and control, and these aspects of the accelerator design are discussed in some detail. Special emphasis is given to the dynamic behavior of the distributed resonant magnet network and its effects on the energy-storage-choke design, the transient characteristics of the pulse power supply, and the part played by model and analog-computer studies during the design stages. (auth)

34827 PERIODIC FOCUSING EFFECT IN DC ACCELERATORS. Gih, Kwang-ta; Chou, Hsi-ting; Chang, Yuan-cheng; Ho, Kuo-chu (Nankai Univ., China). Wu Li Hsueh Pao, 21: 736-47(Apr. 1965). (In Chinese)

The ion-optical properties of an accelerating tube made of a series of coaxial cylinders in a d-c accelerator were investigated. The potential distribution in such an accelerating tube was found both theoretically and experimentally by means of an electrolytic trough. The field in the accelerating tube is found to be not exactly uniform as usually considered, but to include also a periodic part. The paraxial-ray equation for describing the ion trajectory in such a periodic field was solved. The profile of the ion beam does show an undulatory shape, especially in the low-energy region. The periodic field produces a significant focusing effect. A formula for describing the focal length of the ion-optical system was derived. The space charge effect was also considered. (auth)

34828 SHIELDING FROM RADIATION OF ELECTRON ACCELERATORS WITH MAXIMUM ENERGY OF ACCELERATED ELECTRONS TO 30 Mev. Kimel', L. R.; Mashkovich, V. P.; Panchenko, A. M. pp 71-8 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

A simplified method of calculating the shielding of bremsstrahlung and photoneutrons from electron accelerators with maximum energy 30 Mev is presented. Results of a calculation using the given method were verified experimentally by I. P. Bondarenko on the actual machine. The divergence between the calculated and experimental data on the thickness of the shielding wall in the direct beam is about 20%. (M.J.T.)

34829 EMI-SEPARATOR WITH HIGH ACCELERATION VOLTAGE (ACCELERATOR FOR HEAVY IONS) AT THE UNIVERSITY OF AARHUS. Boegh, E.; Dahl, P.; Nielsen, K. O. (Aarhus Universitet, Denmark). 11p. (CONF-578-10). ORINS

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

It is a well-known fact that many EMI separators—although manufactured for another purpose—during recent years were used for examinations of interaction between heavy particles and matter (range, sputtering, ionization phenomena etc...). It is obvious that it will be of value to continue these examinations at energies higher than those

obtainable in normal EMI separators the acceleration voltage of which usually is lower than 70 kv. At the Aarhus University it was therefore decided to build an EMI separator with adjustable acceleration voltage up to about half a million volts. In connection with many examinations (range, radiation damage, etc. . .) it is of value to be able to use a tracer technique; therefore the apparatus will be built in a way that allows experiments with radioactive isotopes. An electrostatic generator for 600 kv and 4 ma, purchased from the firm SAMES, Grenoble (this firm also supplies the accelerator tube) supplies the accelerator voltage. The deflection magnet will be a sector magnet with homogeneous field and inclined boundary at entrance and exit (R = 150 cm, Θ = 75°). The magnet will be supplied by the firm of Kommanditbolaget C. Mileikowsky & Co., Västeras, Sweden. An EMI separator ion source for radioactive isotopes will be used. Ion source and ion source supply will be built at the Institute of Physics, Aarhus. Besides the examinations of interaction between heavy particles and matter, it will be also possible to use the apparatus as an EMI separator, both to produce sources for beta- and gamma-ray spectroscopy, and EMI-separated samples for investigation in the field of solid state physics. (auth)

34830 PARTICLE ACCELERATOR OF THE TYPE SUCH AS A SYNCHROTRON. Herb, Raymond George; Weinmann, James Adolf (to High Voltage Engineering Corp.). German Patent 1,187,749. Feb. 25, 1965. Priority date Apr. 9, 1956, United States.

An accelerator of the synchrotron type is described in which both positive and negative ions are accelerated to at least 10^9 ev, after which the two types of ions are caused to collide. (D.C.W.)

34831 INJECTION DEVICE FOR CIRCULAR ACCELERATOR. Seidl, Milos; Sedlacek, Zdenek; Sunka, Pavel. German Patent 1,191,053. Apr. 15, 1965. Priority date Aug. 25, 1961, Czechoslovakia.

An injection device for circular accelerators (preferably betatrons) is described, which comprises a particle source of any well known type that injects charged particles (preferably electrons) into the vacuum chamber through an injection tube located in the midplane of the chamber and arranged tangentially to the inner periphery of the chamber. The injection tube is made of a ferromagnetic material of high permeability, so that it shields the beam of particles from the guide-field until the beam emerges from the injection tube. Compensation is provided for the distortions of the guide-field caused by the injection tube. (Gmelin Inst.)

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Refer also to abstract 34952.

34832 (AFCRL-64-749) LABORATORY SIMULATION OF LUNAR LUMINESCENCE. Final Report. Geake, J. E. (Manchester Coll. of Science and Tech. (England). Dept. of Physics). July 1964. Contract AF61(052)-379. 10p. (AD-606650). $1.00(CFSTI).

Results of efforts directed toward the laboratory simulation of lunar luminescence effects are summarized. Accomplishments included the design of a special photoelectric spectrophotometer, the development of a proton source for irradiating dust samples, and the measurement of the luminescence spectra of stony meteorites. (auth)

34833 (N64-21485) INTERPLANETARY MAGNETIC FIELDS. A Bibliography of the Open Literature, January 1958–April 1964. Lathourakis, John P. (comp) (Lockheed-California Co., Burbank). May 1964. 44p. (LR-17860)

An unannotated bibliography is presented, comprising a search of the recent unclassified literature on interplanetary magnetic fields. The citations provided refer to direct and indirect observations; theoretical work was not considered. References to interactive forces and the earth's magnetosphere are not complete and are treated in separate sections. 188 references. (auth)

34834 (N64-21684) MAGNETIC FIELDS IN STELLAR PROBLEMS—A REVIEW. Yu, C. P. (Purdue Univ., Lafayette, Ind. School of Aeronautical and Engineering Sciences). Aug. 1963. 42p. (AES-63-9).

A review is given on the theoretical work in the field of stellar magnetism. Four outstanding problems are considered: the origin of magnetic fields, the theory of magnetic variables, the magnetic effect in stellar equilibrium, and the magnetic effect in stellar evolution. A survey of these problems illustrates the difficulties encountered in the present theories. 117 references. (auth)

34835 (N64-22572) SUPERNOVAE, NEUTRINOS, AND NEUTRON STARS. Chiu, Hong-Yee (National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York and Columbia Univ., New York. Dept. of Physics). June 1964. 50p. (NASA-TN-2112). $1.25(CFSTI).

The final evolution of a presupernova star is reviewed. It is believed that the supernova explosion of a star is first triggered by the collapse of its core, followed by the sudden release of gravitational energy or the sudden ignition of nuclear fuel in the envelope. Among the subjects discussed are the causes for stellar collapse, the static structures of white dwarfs and neutron stars, the dynamic collapse of oversized neutron stars, angular momentum and stellar collapse, and the observable features of neutron stars. 49 references. (auth)

34836 (N64-22765) SOME PHILOSOPHICAL ROOTS OF MODERN COSMOLOGICAL THEORIES AND THE CRITICAL TESTS BETWEEN THEM. Plagemann, Stephen (California Univ., Berkeley. Space Sciences Lab.). Oct. 11, 1963. 20p. (NASA-CR-55177). $1.60(CFSTI).

The basic premises of the steady-state and evolutionary theories in cosmology are discussed with reference to two diverging views about physical theories. Various theoretical arguments against the theories are examined and shown to be insufficient. The critical experimental tests between the cosmological theories are presented briefly. They are analyzed with the view that their successful completion depends upon future developments in the astronomical sciences. (auth)

34837 EXPANSION AS AN ENERGY SOURCE IN QUASISTELLAR RADIO SOURCES. Ne'eman, Yuval (California Inst. of Tech., Pasadena). Astrophys. J., 141: 1303-5 (May 15, 1965). (CALT-68-23)

The Greenstein-Schmidt model of some quasi-stellar radio sources distinguishes between low-density filaments where radio and redshifted optical radiation is emitted, and a small dense core responsible for continuum radiation and variability. It is suggested here that the system's energy originates from expansion in the dense core; this expansion is viewed as an inhomogeneity of the general expansion of the universe in conventional general relativity. (auth)

34838 POSITRON-CAPTURE PROCESSES AS A POSSIBLE SOURCE OF THE p ELEMENTS. Reeves, Hubert; Stewart, Pierre (Universite, Montreal). Astrophys. J., 141: 1432-8(May 15, 1965).

When the interior temperature of a star reaches the range $T_9 = 1-2$, the process of pair creation by gamma radiation builds up an equilibrium concentration of positrons. If the stellar material contains a certain amount of s elements, these elements may undergo a positron-capture reaction and be transformed into a proton-rich (usually unstable) isobar. This isobar will then spontaneously decay (at least part of the time) into a stable (proton-richer) isobar usually referred to as a p element. In this paper the lifetime for the positron capture leading to the existing p elements is computed. In many cases the lifetimes are short enough to be of importance in astrophysical circumstances. The case of the isobar ^{164}Er is discussed in more detail. (auth)

34839 ON HIGHLY ROTATING POLYTROPES. [PART] V. Limber, D. N.; Roberts, P. H. (Univ. of Chicago). Astrophys. J., 141: 1439-42(May 15, 1965).

The effect of rapid rotation upon the thermonuclear en-

ergy release in polytropes is discussed. The numerical results rest upon models developed in the earlier papers of the series. The conclusions are presented as comparisons between rotating and non-rotating polytropes having either the same central temperatures and densities or the same total luminosities and mean effective temperatures. (auth)

34840 THE EQUILIBRIUM STATE OF A SHOCK-HEATED ATMOSPHERE. Bird, G. A. (Univ. of Manchester, Eng.). Astrophys. J., 141: 1455-62(May 15, 1965).

Equations are developed to describe an atmosphere heated by an arbitrary distribution of shock waves. Solutions are obtained for an atmosphere with a steady outward mass motion ("solar wind") in which the heat supplied by the shock waves is balanced by the convective heat loss due to this motion. The boundary conditions for the solution are those appropriate to the outer solar atmosphere. It is found that there is a strong "self-regulating" property of shock-heated atmospheres, in that very large changes in the initial heat input are compensated by the subsequent changes in shock strength. This means that, for a very large range of shock strengths and frequencies, the temperature profile is similar to that predicted by the "constant shock strength hypothesis." The maximum coronal temperature varies by only a few per cent from 1600000°K while the initial heat input varies by a factor of thousands. However, the outward mass flux increases continuously with the initial heat input and, for very large initial inputs, the maximum temperature also rises appreciably. (auth)

34841 DYNAMICAL PROPERTIES OF STELLAR CORONAS AND STELLAR WINDS. IV. THE SEPARATE EXISTENCE OF SUBSONIC AND SUPERSONIC SOLUTIONS. Parker, E. N. (Univ. of Chicago). Astrophys. J., 141: 1463-78(May 15, 1965).

The dynamical equations are considered for a stationary stellar corona whose energy is supplied only by thermal conduction from its base and which is surrounded by a cold vacuum. The density and temperature at the base of the corona are denoted by N_0 and T_0, respectively. It is shown that subsonic and supersonic expansion of such a minimum stellar corona are separated by a density $N_B(T_0)$: If $N_0 < N_B(T_0)$, the expansion is supersonic; if $N_0 > N_B(T_0)$, the expansion is subsonic. Observations suggest that $T_0 \cong 1 \times 10^{6}$°K for the quiet solar corona, so that $N_B(T_0) \cong 3 \times 10^{10}$/cm^3. The observed densities are 10^8–10^9/cm^3, requiring supersonic expansion. Detailed comparison of this theoretical corona of minimum heating with the observed solar temperatures, densities, and expansion velocity suggests that the solar corona is, in fact, heated in depth. (auth)

34842 CONDUCTIVE HEATING OF THE SOLAR WIND. II. THE INNER CORONA. Scarf, F. L.; Noble, L. M. (TRW Space Technology Labs., Redondo Beach, Calif.). Astrophys. J., 141: 1479-91(May 15, 1965).

New numerical solutions to the Navier-Stokes equations are used to describe the streaming solar atmosphere. It is argued that no external heat input is needed beyond about 2 R⊙ if the coronal base temperature is near 1.5×10^{6}°K and the plasma has a uniform 10% concentration of helium. In the subsonic region, thermal conduction dominates the flow and viscous effects are unimportant. The transition to supersonic flow occurs near 7 R⊙, and beyond this radius viscous forces are extremely significant. It is shown that solutions to the inviscid model are singular and that they are not related to the limiting solutions for small, but finite, viscosity. (auth)

34843 A STUDY OF THE DEVELOPMENT OF ACTIVE REGIONS ON THE SUN. Bumba, V. (Astronomical Inst., Observatory Ondrejov, Academy of Sciences, Czechoslovakia); Howard, Robert. Astrophys. J., 141: 1492-1501 (May 15, 1965).

The early development of a large number of active regions was studied. Magnetic, photospheric, and chromospheric observations from Mount Wilson were used. It was found that the supergranular pattern of the solar atmosphere plays a very fundamental role in the development of active regions. New regions form in or immediately adjacent to expanding weak old regions that are seen as an enhanced calcium network. The first appearance of the new calcium plage (also of sunspots) takes place in the space between several supergranules, and the subsequent brightening occurs between supergranules, usually filling in several of them. In many cases it appeared that during the first day or two of the development of the group, the magnetic fields did not show zero net flux. Usually the direction of the development of the plage was from following to leading. The increase of magnetic flux (the initial growth of the plage) takes place only during the first few days in the life of a region. During this period the boundary of the filamentary structure in Hα increases at the rate of about 200 m/sec. This evidently represents the rapid ordering of magnetic fields around the plage. (auth)

34844 LARGE-SCALE DISTRIBUTION OF SOLAR MAGNETIC FIELDS. Bumba, V. (Astronomical Inst., Observatory Ondrejov, Academy of Sciences, Czechoslovakia); Howard, Robert. Astrophys. J., 141: 1502-12 (May 15, 1965).

Solar magnetograms covering a period of 4½ years were used to study the distribution of weak magnetic fields on the solar surface. The semiregular pattern of these background fields is the result of the expansion, weakening, and stretching by differential rotation of magnetic fields of old active regions and their interaction with neighboring fields, and of the continuing development of magnetic fields of new regions within the pattern. The net result is a slowly changing pattern of background fields which occupies at times during the solar cycle more than 50% of the surface area of the sun, as seen with the 23″ resolution of the magnetograph. The interaction of nearby magnetic fields takes the form of the apparent attraction of features of the same polarity and the apparent repulsion of features of opposite polarity. Sometimes weak magnetic features covering a large area apparently disappear over a period of a few rotations. It is not clear from the observations what the mechanism of this disappearance could be. It is clear from the period near minimum that active regions are concentrated in complexes of activity whose location and development are clearly defined. The largest of these complexes, consisting of many active regions, result in the formation of Unipolar Magnetic Regions (UMR). The polar fields are discussed from the standpoint of the poleward drift of the UMR's. (auth)

34845 THE EXISTENCE OF A MAJOR NEW CONSTITUENT OF THE UNIVERSE: THE QUASI-STELLAR GALAXIES. Sandage, Allan (California Inst. of Tech., Pasadena). Astrophys. J., 141: 1560-78(May 15, 1965).

Photometric, number count, and spectrographic evidence is presented to show that most of the blue, starlike objects fainter than $m_{pg} = 16^m$ found in color surveys of high-latitude fields are extragalactic and represent an entirely new class of objects. Members of the class called here quasi-stellar galaxies (QSG) resemble the quasi-stellar radio sources (QSS) in many optical properties, but they are radio-quiet. The QSG brighter than $m_{pg} = 19^m$ are 10^2 times more numerous per square degree than the QSS that are brighter than 9 flux units. The surface density of QSG is about 4 objects per square degree to $m_{pg} = 19^m$. The evidence is developed in three parts: (1) Photoelectric photometry shows that a fundamental change occurs in the color distribution of high-latitude blue objects at about $V = 14.5^m$. Brighter than this, the objects fall near the luminosity class V line of the U–B, B–V diagram. Fainter than this, 80% of the objects lie in the peculiar region known to be occupied by the quasi-stellar radio sources. (2) The observed integral-count-curve, log N(m), for objects in the Haro-Luyten catalogue undergoes a profound change of slope between $m_{pg} = 12^m$ and $m_{pg} = 15^m$, steepening and reaching a constant slope for m_{pg} fainter than 16^m. This magnitude interval is the same as that in which the color distribution changes, as discussed above. The slope fainter than 16^m is d log N(m)/dm = 0.383. It is shown that this is the expected value from the theory of cosmological num-

ber counts for uniformly distributed objects with large redshifts. (3) Spectra of five of the faint blue objects are similar to spectra of quasi-stellar radio sources. Intense, sharp emission lines of forbidden [O(III)], [O(II)], and [Ne(III)], together with very broad (35 Å wide) lines of Hβ, Hγ, Hδ, Hε, and [Ne(V)] are present in two of the five. Two broad emission lines are present in another at λ 3473 and λ 4279, identified as C(IV) (1550) and C(III) (1909). The other two objects have featureless spectra with only a blue continuum showing. The redshifts ($\Delta\lambda/\lambda_0$) for the three objects with lines are 0.0877, 0.1307, and 1.2410. The position of the objects in the redshift-apparent-magnitude diagram shows each of the three to be superluminous. The space density of the quasi-stellar galaxies is estimated to be about 5×10^{-8} QSG/cm^3, which is to be compared with the space density of normal galaxies of about 1×10^{-75} galaxies/cm^3. The ratio, per unit volume of QSG to QSS is estimated to be 500, which gives a lifetime of the QSG phase as 5×10^8 years if the lifetime of the radio source is 10^6 years. The objects would seem to be of major importance in the solution of the cosmological problem. They can be found at great distances because of their high luminosity. QSG at B = 22^m are estimated to have a mean redshift of $\Delta\lambda/\lambda_0 \simeq 5$ for a model universe of $q_0 = +1$. At these redshifts, we are sampling the universe in depth to 0.63 of the distance to the horizon (for $q_0 = +1$), and are looking back in time more than 0.9 of the way to the "creation event" in an evolutionary model. Study of the [m,z]- and log N(m)-curves using the QSG should eventually provide a crucial test of various cosmological models. But even more important, comparative study of the quasi-stellar galaxies and the intimately connected quasi-stellar radio sources is expected to shed light on the evolutionary processes of the violent events that characterize the two classes. (auth)

34846 3C 343, A DOUBLE RADIO SOURCE WITH VERY WIDE COMPONENT SEPARATION. Moffet, Alan T. (California Inst. of Tech., Pasadena). Astrophys. J., 141: 1580-2(May 15, 1965).

The radio source 3C 343 was earlier resolved into two components of equal intensity. Recent additional observations have been made of 3C 343 using the Caltech interferometer at frequencies of 1421 and 2842 Mc. The two components are found to have very nearly equal intensities at all frequencies. There is no satisfactory optical identification, although a moderately bright galaxy lies within the smallest circle that can circumscribe the source. (J.F.P.)

34847 A GENERAL FORMULA FOR THE ESTIMATION OF DIELECTRONIC RECOMBINATION COEFFICIENTS IN LOW-DENSITY PLASMAS. Burgess, Alan (University Coll., London). Astrophys. J., 141: 1588-90(May 15, 1965).

A simple formula is obtained for the estimation of dielectronic recombination coefficients in low-density plasmas. The main error in this general formula might arise from the use of representative cross section ratios. Also it is stressed that the results apply only to the case of low particle and radiation densities. Fairly rough estimates indicate that they are valid in typical coronal conditions. (J.F.P.)

34848 HOW OLD ARE THE GALAXIES. Firsoff, V. Axel (Royal Astronomical Society, London). Discovery, 26: 20-5(Feb. 1965).

The nature and evolution of galaxies are described, and some attempts at estimating their ages are discussed. The role of nuclear reactions in the evolution of galaxies is also considered. Estimates of the ages of galaxies are included; they appear to rule out the big-bang and steady-state theories of the expansion of the universe. (D.C.W.)

34849 IS THE UNIVERSE EXPANDING. Firsoff, V. Axel (Royal Astronomical Society, London). Discovery, 26: 18-21(Apr. 1965).

The evolutionary "big-bang" theory and the steady-state theory of the universe are examined critically. It is concluded that the latter concept is more acceptable. Specifically, it is concluded that the universe is a self-regulating system, subject to a cycle of about 1.3×10^{13} yr, within which its entire mass is renewed by conversion of mass to radiation, which is subsequently converted to mass. (D.C.W.)

34850 IONOSPHERIC ANOMALIES AS INDICATORS OF IONIZING RADIATION FROM A CORPUSCULAR CLOUD AFTER A SOLAR CHROMOSPHERIC FLARE. Nestorov, G.; Krivskii, L.; Letfus, V. (Geophysical Inst., Sofia and Astronomical Inst., Prague). Geomagnetism Aeronomy (USSR) (English Transl.), 4: 822-4(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1059-(1964).

A sharp increase in solar radio emission in the decimeter and meter ranges as well as an increase in cosmic radio noise at a frequency of 29 Mc/s and of atmospheric radio noise at a frequency of 27 kc/sec were recorded at the Ondrejov astronomical observatory after the solar chromospheric flare of importance 2+ on September 16, 1963. Several hypotheses are advanced to explain this case. The nature of the phenomena that occurred after the flare is investigated on the basis of data for ionospheric absorption of long, medium, and short waves, obtained at Sofia during the same period. (auth)

34851 ANALOG OF THE ZEEMAN EFFECT IN THE GRAVITATIONAL FIELD OF A ROTATING STAR. Zeldovich, Ya. B. JETP Letters (USSR) (English Transl.), 1: 95-7(May 1, 1965).

The effect is considered of the variation of the gravitational field due to the rotation on the spectrum emitted by atoms on the surface of the body and observed by a receiver far away. The components of the gravitational field, in analogy with the magnetic field, produce in the spectrum changes similar to the Zeeman effect. (J.F.P.)

34852 LACK OF EFFECT OF Io ON JOVIAN 3.75-cm EMISSION. Dickel, John R. (Univ. of Illinois, Urbana). Nature, 206: 1241-2(June 19, 1965).

The effects of Io on the synchrontron emission generated within the radiation belts in Jupiter's magnetosphere were studied. Results for flux density and positron angle of the polarized radiation showed a similar lack of correlation with the position of Io. Therefore, while Io is observed to have an effect on the localized regions responsible for the decameter bursts, it does not influence the overall structure of the Jovian magnetosphere, which is responsible for the non-thermal emission at centimeter wave-lengths. (P.C.H.)

34853 EMPIRICAL ADMISSIBILITY OF AN EINSTEIN COSMOLOGICAL MODEL. Rosen, G. (Southwest Research Inst., San Antonio, Tex.). Phys. Letters, 17: 108-9(July 1, 1965).

A satisfactory estimate of the age of the universe and a more accurate value for the reciprocal Hubble expansion show that the Einstein cosmological model is admissible according to the best empirical information. The present empirical situation favors an Einstein model with negative spatial curvature. (J.F.P.)

34854 SOLAR TYPE IV RADIO EMISSION AND THE STRUCTURE OF THE SUNSPOT MAGNETIC FIELDS ABOVE THE FLARE REGIONS. Sakurai, Kunitomo (Kyoto Univ.). Rept. Ionosphere Space Res. Japan, 18: 366-76 (1964).

On the basis of emission characteristics and differences between the onset times of three solar type IV radio outburst components (μ-IV, dm-IV, and m-IV emissions), the movement of radio sources, certain information on solar flare sources, and the structure of sunspot magnetic fields are considered. It is obvious that there is an east-west asymmetry on the solar longitude concerning these time differences, from the onset time of μ-IV emission to those of the other two dm-IV and M-IV emissions. Using the above results of asymmetry, the structure of the sunspot magnetic fields may be inferred, under some assumptions on the radio source movement. The results are summarized as follows: Field intensity of the leading sunspots are

much stronger compared with that of the following ones. Sunspot magnetic fields consist of dipolar fields tilted westward, imbedded deeply in the photosphere. Most solar flares tend to occur near the eastern side of the leading spots in which the magnetic polarity of sunspots is reversed. Radio sources of outbursts will be ejected from the flare regions at the same time as the beginning of the flare's explosive phase and will move almost spherically with a velocity of the order of 1000 km/sec. The emission mechanism of the outburst may be due to snychrotron radiation by high energy electrons trapped within the magnetic fields of sunspots. The structure of the sunspot magnetic fields deduced will be favorable for the interpretation of solar cosmic ray propagation in the interplanetary space. (auth)

34855 X-RAY PRODUCTION IN INTERPLANETARY SPACE. Hayakawa, Satio; Matsuoka, Masaru (Nagoya Univ., Japan). Rept. Ionosphere Space Res. Japan, 18: 458-60(1964).

The intensity of x rays emitted in interplanetary space is estimated. It is shown that it is significantly less than the intensity of galactic x rays in the solar quiet period, while during an active period, the intensity could be so high as to be stronger than, or comparable to the galactic intensity. In the latter case, observation of interplanetary x rays will provide information on the properties of the solar plasma stream. Among the possible mechanisms of the x-ray emission in interplanetary space, thermal emission from interplanetary plasmas is concluded to be the most important one. (J.F.P.)

34856 RADIOASTRONOMICAL OBSERVATIONS OF SOLAR ECLIPSE JUNE 21, 1963 AT CENTRIMETRIC WAVE RANGE. Abbasov, A. R.; Grebinskii, A. S.; Durasov, M. S. (and others). Vestn. Leningr. Univ., No. 1, Ser. Mat., Mekhan, i Astron., No. 1, 102-9(1965). (In Russian)

The preliminary results of radioastronomical observations of solar eclipse of June 21, 1963 are given. The conclusions about negligible dependence of solar radiodiameter determined by moments of II and III contacts from wavelength in the region from 2 to 10 cm are made. The spectrum of radioemission source above a small group of spots has maximum in band from 3.2 to 10 cm. (auth)

34857 FUNDAMENTALS OF SPACE MANEUVERS. Clarkson, Mark H. (Univ. of Florida, Gainesville). p. 1-29 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

The motion of bodies in a Newtonian force field is analyzed, with specific consideration of the case of two bodies of unequal mass. A simplified analysis of a trip to the moon is also included in which vertical ascent, injection into a circular orbit, transfer to a cis-lunar orbit, transfer to a lunar orbit, and the landing maneuver are treated. (D.C.W.)

34858 SPACE PHYSICS. Massey, Harrie. Cambridge, Eng., University Press, 1964. 243p. $6.50(Cloth); $2.95(Paper).

A presentation is given of research into the nature of the earth's atmosphere, ionosphere, solar and stellar radiation, interplanetary plasma, and lunar and interplanetary exploration. The techniques and methods involved in such research and the results that have been obtained so far are discussed. The physical significance of the results is stressed. (J.F.P.)

34859 GRAVITATION THEORY AND GRAVITATIONAL COLLAPSE. Harrison, B. Kent; Thorne, Kip S.; Wakano, Masami; Wheeler, John Archibald. Chicago, The University of Chicago Press, 1965. 190p. $6.50.

A mathematical analysis is given to cosmological properties. Properties of the universe and of space are discussed in the light of various theories. Collapse is seen as inevitable. Conditions after collapse are also discussed. (J.F.P.)

Atomic Physics

Refer also to abstracts 35319 and 35507.

34860 (AD-613073) ELECTRON-IONIZATION CROSS SECTIONS. Semiannual Progress Report No. 3, June 15-December 15, 1964. Crawford, C. K.; Roddy, F. R. (Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research). Contract AF33(657)-10939. 15p. $1.00(CFSTI).

The wire-wound ionization-chamber technique was given its initial tests. Performance was satisfactory. Two electron monochrometers were constructed; testing is in progress. The design and procurement of a new set of standard parts were completed. Ionization cross-section measurements for titanium were initiated. (auth)

34861 (JINR-P-2121) ELEKTROMAGNITNAYA STRUKTURA PROTONA I SVERKHTONKOE RASSHCHEPLENIE V VODORODE. (Electromagnetic Structure of the Proton and Hyperfine Splitting in Hydrogen). Tyukhtyaev, Yu. N.; Faustov, R. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 8p. Dep.(mn).

The quasipotential equation for a system of two fermions is used to investigate the effect of the electromagnetic proton form factors on the hyperfine structure of the ground state of the hydrogen atom. A correction of the relative order a(m/M) to the Fermi formula is calculated. A comparison is made between the theoretical and experimental values of the hyperfine splitting in hydrogen. (auth)

34862 (N64-27381) PLANETARY PHYSICS. IV. AN EXPANSION METHOD FOR CALCULATING ATOMIC PROPERTIES. I. THE ^2S AND $^2P^0$ STATES OF THE LITHIUM SEQUENCE. Cohen, M.; Dalgarno, A. (Geophysics Corp. of America, Bedford, Mass.). [nd]. Contract NASw-840. 31p. (NASA-CR-57010; GCA-TR-64-5-N). $3.60 (CFSTI).

An expansion method is used to calculate the expectation values of various operators for the lowest ^2S and $^2P^0$ states of all members of the lithium sequence. The method is extended to the calculation of matrix elements connecting the two states, and the electric dipole transition integrals are calculated. A comparison with the results of more refined calculations shows that despite its simplicity the method is capable of high accuracy. (auth)

34863 (N64-30048) EFFECTIVE RADIUS OF A CESIUM ATOM IN GROUND STATE AND FIRST EXCITED STATE. Kampos, Samuel (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1964. 5p. (NASA-TM-X-52057) $1.10(CFSTI).

The effective radius of neutral cesium in the ground state and in the first excited state is calculated through the use of Stone's wave functions. The values are 2.98 and 4.12 Å for the 6s and 6p states, respectively. An application of the radial information is made to cesium polarizability calculations. (auth)

34864 (NASA-TN-D-2903) COMPARISON OF GRYZINSKI'S AND BORN'S APPROXIMATIONS FOR INELASTIC SCATTERING IN ATOMIC HYDROGEN. Monnin, Carl F.; Prok, George M. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). June 1965. 23p. $1.00(CFSTI).

Excitation cross sections for electron scattering in atomic hydrogen were determined by the Born approximation from the ground state to all excited states up to the 4f level. Gryzinski's semiclassical theory was used to obtain similar cross sections. Because of the small differences in energy between various energy levels of a principal quantum level, however, only the sum of cross sections for all transitions to the principal quantum level can be determined. Results of this method were compared with the sum of the individual sublevel cross sections determined by the Born approximation. Cross sections are presented for transitions from the ground state to n = 2, 3, 4, and ionization. The theoretical cross sections are com-

pared with experiment for the 1s → 2s, 1s → 2p, and 1s → ionization transitions. In addition, calculations of Gryzinski's electron exchange cross section were performed for the 2s, 3s, and 4s levels. Gryzinski's theory gave lower excitation cross sections than Born's approximation for all transitions up to n = 4 and for ionization. In the energy range considered (threshold to 360 ev), the cross sections resulting from the two theories are quite similar in shape and differ at various electron energies by a factor between 2 and 4. The exchange cross section of Gryzinski agrees very well with experiment for the 1s → 2s transition below 40 ev. (auth)

34865 (TID-21088) THE K-SHELL EXCITATION FUNCTION. Khandelwal, G. S.; Merzbacher, E. (North Carolina Univ., Chapel Hill). [1964]. Contract AT(40-1)-2408. 13p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The K-shell excitation function $I(\eta_K,W)$ was evaluated for a broad range of the parameters η_K and W (functions of the effective nuclear charge seen by the K-shell electron and the energy transfer for a transition from the K-state to the continuum state), using the UNIVAC 1105 computer; results are tabulated. In the calculations, the plane wave Born approximation for the charged-particle inelastic-scattering cross section on atoms was used, in which the initial and final state of the projectile are represented by plane waves, neglecting all distortions, and the perturbations of the atomic orbits between which transitions are induced are neglected. (M.J.T.)

34866 (UCRL-7946) DISSOCIATION OF VIBRATIONALLY EXCITED MOLECULAR HYDROGEN IONS ON HYDROGEN GAS. Chambers, E. S. (Lawrence Radiation Lab., Univ. of California, Livermore). June 24, 1964. Contract W-7405-eng-48. 15p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

By appropriate operation of the hydrogen ion source, H_3^+ ions were obtained that have an abnormally high cross section for the dissociation reaction $H_3^+ + H_2 \rightarrow H_2^+ + H + H_2$. The cross section increases with energy from 6 Å² at 5 kev to 10 Å² at 50 kev. "Normal" ions gave 1.5 Å² to 2.5 Å² over the same range. The companion reaction of H_3^+ giving H^+ has a cross section varying from 0.5 Å² at 5 kev to 1.6 Å² at 35 kev. Corresponding cross sections for "vibrationally excited" ions are about 0.25 Å² higher. The dissociation of H_2^+ to give H^+ has a cross section of about 1.6 Å² over the range 5 to 45 kev. The molecular ion H_3^+ has been obtained from the source. Its dissociation to H^+ with one-fifth the energy has a cross section of 3.2 Å² at 20 kev and is independent of source condition. Excited H_3^+ may prove to be useful for transverse injection into a mirror machine. (auth)

34867 VARIATIONAL TREATMENT OF ATOMIC COLLISIONS. Joachain, C. (Universite Libre, Brussels). Ann. Inst. Henri Poincare, Sect. A, 1: 55-77(1964). (In French)

The Schwinger variational principle for the scattering amplitude is applied to the study of atomic direct collisions. Detailed calculations are carried out for electron and positron elastic scattering by hydrogen and helium atoms in the static approximation. It is found that Schwinger's stationary expression gives accurate results in a very large energy region. Comparison with first and second Born approximations is also made. (auth)

34868 AN EXPERIMENTAL DETERMINATION OF THE ANGULAR DISTRIBUTIONS OF PHOTOELECTRONS FROM THE DIFFERENT L SUBSHELLS IN GOLD AT Ey = 412 Kev. Bergkvist, Karl-Erik. Arkiv Fysik, 27: 483-500(1965).

An experimental investigation of the angular distributions of L shell photoelectrons from gold was performed, utilizing 412-kev γ rays. A separation of the contributions from the L(I), L(II), and L(III) shells was made possible by applying a new experimental technique based on the use of an electrostatic-magnetic β spectrometer combining very high luminosity with high resolving power. This spectrometer permitted the use of an efficient geometry and also the possibility to apply a method for the reduction of the Compton background, thus extending the possibilities to record the photo lines at angles where the differential cross sections are small. The results are compared with theories of Pratt and Gavrila. The L(I) distribution was found to have the same shape as the K distribution as predicted by both of these theories. The L(II) and L(III) distributions were found to be more forward peaked than the L(I) distribution, this difference being especially pronounced for the L(II) shell. Whereas the experimentally found ratio between the total photo cross sections for the L(II) and L(III) shells differs by about a factor of three from the ratio predicted by the theory of Gavrila (which assumes $\alpha Z \ll 1$), the experimental angular distributions for the L(II) and L(III) shells were found to show roughly the same behavior as implied by this theory. The relations between the experimental K, L(I), L(II), and L(III) total photo cross sections were found to be 8.5 ± 0.5, 1, 0.30 ± 0.03, and 0.18 ± 0.02, respectively, in reasonable agreement with the predictions of Pratt. (auth)

34869 MULTIPLE SCATTERING OF 5-30 kev ELECTRONS IN EVAPORATED METAL FILMS. III. BACKSCATTERING AND ABSORPTION. Cosslett, V. E.; Thomas, R. N. (Cambridge Univ., Eng.). Brit. J. Appl. Phys., 16: 779-96(June 1965).

Measurements were made of the fraction of an electron beam backscattered from thin films of copper and gold at incident energies from 5 to 25 kev. The results from very thin films indicate that approximately 50% of backscattering from a solid target must be due to single scattering. A comparison with existing theories shows that the results can be fitted by a combination of the single scattering treatment of Everhart and the albedo theory of Bothe, if recent experimental values of the electron range are inserted. A degree of agreement is also obtained with the comprehensive theory of backscattering due to Dashen. The fraction of the electron beam absorbed in a film of given thickness, found by subtracting the sum of the transmitted and backscattered fractions from unity, may be corrected by a simple procedure to give the fraction absorbed in a layer of equal thickness at the surface of a solid target. The resulting electron distribution in depth is obtained for different incident energies; that for copper at 20 kev agrees fairly well with a Monte Carlo calculation. The fraction of the energy absorbed within given depth and the energy dissipated per unit thickness are similarly derived. The latter distributions are sharply peaked just below the surface. Those for 20 kev agree well with the computations of Spencer, but less closely with Ehrenberg and King's observations of cathodoluminescence in phosphors. Regarded as a depth-dose distribution, the curve for copper at 20 kev agrees in general form with the measurements of characteristic x-ray production made by Castaing and Descamps. But there are significant differences between the energy distributions for copper and gold at the same incident energy, and also between the distributions at 10 and 20 kev, which may have implications for probe microanalysis. (auth)

34870 WHEN ATOMS COLLIDE. Massey, Harrie Intern. Sci. Technol., No. 43: 44-50(July 1965).

The properties and behavior of atoms in gases is discussed. This discussion includes quantized states cross sections, measurements with microwaves, and ionospheric phenomena. The various effects produced by atomic collisions are also noted. (J.F.P.)

34871 POSITRONIUM INTERACTIONS IN AQUEOUS SOLUTIONS. Horstmann, H. (Carnegie Inst. of Tech., Pittsburgh). J. Inorg. Nucl. Chem., 27: 1191-1203(June 1965).

The ortho-positronium formed in aqueous solutions decays mostly via two-quantum annihilation giving rise to the so-called long-lived component. Survey measurements were made of the temperature dependence of the long lifetime τ_2, and of the percentage I_2, of positrons which decay with this lifetime in various solutions. No temperature dependence was found in solutions in which only pick-off occurs. In solutions in which the positronium atom is oxi-

dized, τ_2 decreases and I_2 increases with increasing temperature. The oxidation rates were found to have a temperature dependence corresponding to activation energies of the order of 0.1 ev and the measured dependence of I_2 on the oxidation rate gave free positron annihilation lifetimes in the range of 0.35 to 0.60 nsec. In solutions of paramagnetic salts the lifetime, in general, decreased and I_2 increased with increasing temperature. (auth)

34872 CHARGE EXCHANGE OF Cl^- IONS WITH ATOMIC CHLORINE. Karmohapatro, S. B. (Saha Inst. of Nuclear Physics, Calcutta). J. Phys. Soc. Japan, 20: 839-41(May 1965).

The cross sections of the charge exchange of the fast negative-chlorine atomic ions in atomic chlorine are calculated by the impact parameter method. Values of the cross sections range between 404.772×10^{-16} cm^2 and 129.93×10^{-16} cm^2 for the energies 25 ev and 90 kev of Cl^- ions, respectively. The above cross sections are a few times larger than those of the similar symmetric positive ion-atom charge-exchange reactions. For Cl^- in chlorine, the cross sections are even higher than that of H^- in atomic hydrogen, calculated by Dalgarno and McDowell with the PSS method. (auth)

34873 SPHERE TRANSMISSION METHOD FOR THE MEASUREMENT OF ATOMIC PHOTO-ELECTRIC CROSS-SECTIONS. A. M. Ghose (Bose Inst., Calcutta). Nucl. Instr. Methods, 35: 45-54(1965).

A method for the measurement of atomic photoelectric cross sections of high-Z atoms is described, based on the measurement of photon transmission through spherical shells of absorbers. Theoretical calculations are presented to consider the effects of multiple scattering in the absorber shell. It is shown that the absorption in the shell can be approximated by an effective cross section which can be expanded in a polynomial in the thickness of the shell. The effect of truncating the polynomial by another polynomial of lower order is discussed. Formulas for the evaluation of correction factors for the finite size of the source, self-absorption in the source, non-uniformity of the detector sensitivity, scattering in the absorber holders, small deviations from spherical symmetry in the experimental arrangement and for pair production in the absorber are derived. (auth)

34874 s-f SCATTERING IN RARE-EARTH METALS. Van De Braak, H. P.; Caspers, W. J. (Inst. for Crystal Physics, Groningen, Netherlands). Phys. Letters, 16: 212-13(June 1, 1965).

Caspers (Physics, 30: 45(1964)) derived a general form for the exchange potential, which described the interaction between the conduction electrons and magnetic ions in a metal. The influence of this potential on the s-f scattering in rare-earth metals is considered. (M.O.W.)

34875 A MATCHING PROCEDURE FOR SCATTERING WITH THE BORN-MAYER POTENTIAL AT LOW ENERGY TRANSFERS. Lawson, R. P. W.; Corkhill, D. P.; Carter, G. (Dept. of Electrical Engineering, Liverpool). Phys. Letters, 16: 257-8(June 1, 1965).

In previous methods, cut-off is effected at a fixed distance and hence tends to underestimate scattering in distant collisions. A discussion of a method of matching that is appropriate for distant collisions, and which allows for the energy dependence of scattering is presented. The matching of the potential $V_m(r) = B(r_c/r - 1)$ to the Born-Mayer potential $V(r) = A \exp(-r/a)$ with the constants A = 22.5 kev, a = $\frac{1}{13}$ lattice spacing appropriate to copper is discussed. (M.O.W.)

34876 THE VELOCITY DEPENDENCE OF THE TOTAL SCATTERING CROSS SECTION OF K ON RARE GASES. Von Busch, Fr. (Universitat, Bonn); Strunck, H. J.; Schlier, Ch. Phys. Letters, 16: 268-9(June 1, 1965).

A precise method for the measurement of the velocity dependence of atomic total cross sections is presented. By use of a double atomic beam with two velocity selectors the cross sections for two different velocities are directly compared. The result consists of the ratios $Q(v)/Q(v_0)$ with some $Q(v_0)$ taken as a reference. Curves for the scattering of K on Ar, Kr, and Xe are given. (M.O.W.)

34877 CROSS SECTIONS FOR CHARGE EXCHANGE OF XENON IONS,WITH RARE GASES. Brouillard, F.; Caudano, R. (Universite, Louvain, Belg.). Phys. Letters, 16: 276-7(June 1, 1965).

The total cross sections were derived from the attenuation of the primary ion currents. From the measurement of the charge exchange currents, each related to its parent ion current, the cross sections for charge exchange are determined. Ionization was assumed to be negligible as compared with electron capture. (M.O.W.)

34878 EXCITATION OF ATOMIC HYDROGEN BY LITHIUM ATOMS. Cheshire, I. M.; Kyle, H. L. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Letters, 17: 115-16(July 1, 1965).

The excitation of atomic hydrogen in collisions with lithium atoms is considered with the Born cross section for lithium in the ground state and in the excited γ state. The upper bounds for the total Born cross section are tabulated. It is noted that the application of a simple hydrogenic wave function increased the tabulated values by about 20%. (J.F.P.)

34879 ELASTIC DIFFERENTIAL SCATTERING OF He^+ IONS BY He IN THE 20-600 eV RANGE. Lorents, Donald C.; Aberth, William (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev., 139: 1017-24(Aug. 16, 1965).

Absolute elastic differential scattering cross sections for He^+ on He were measured at relative energies of 20 to 600 ev over an angular range of 1–36°. The ions are extracted from an electron-bombardment source, formed into a ribbon beam by a pair of slits, and scattered in a gas cell containing He. The scattered beam is energy-analyzed and then detected by an electron multiplier. The relative data are normalized to absolute cross sections obtained at small angles using a Faraday cage in place of the multiplier. The effect of geometry, target-particle motion, and inelastic scattering on the angular resolution of the elastic cross sections is discussed. Three distinct interference phenomena are observed: (1) a series of smooth sinusoidal oscillations resulting from interference between the waves scattered from the gerade and ungerade potentials of the molecular ion, (2) rainbow scattering, (3) secondary oscillations at large angles due to nuclear interchange. (auth)

34880 EXCITATION OF OPTICALLY FORBIDDEN STATES IN THE IONIZATION CONTINUUM BY ELECTRON IMPACT. Simpson, J. Arol; Chamberlain, G. E.; Mielczarek, S. R. (National Bureau of Standards, Washington, D. C.). Phys. Rev., 139: 1039-41(Aug. 16, 1965).

The inelastic-electron-scattering resonances in the ionization continuum of He, Ne, and Ar were recorded as a function of primary energy. The energy resolution was ~0.1 ev, the angular resolution $\Delta\theta$ was $\sim 10^{-2}$ rad about the forward direction, and the primary energy was between 60 and 400 ev. The strength of resonances due to optically forbidden transitions from the ground state compared with those due to optically allowed transitions increases as the energy is reduced, as was expected. A marked difference between ^1D and ^1S behavior exists, and certain resonances, notably that due to the $(3s3p^64p)^1P$ state in Ar, change shape as the energy is reduced. At the highest energies used the resonances due to optically forbidden transitions were still apparent. (auth)

34881 METHOD FOR CALCULATING MATRIX ELEMENTS BETWEEN CONFIGURATIONS WITH SEVERAL OPEN l SHELLS. Shore, Bruce W. (Harvard Coll. Observatory, Cambridge, Mass.). Phys. Rev., 139: 1042-8(Aug. 16, 1965).

A simple procedure applicable to a digital computer is given for calculating matrix elements of F- and G-type operators between configurations that involve several partially filled l or j shells. The new procedure uses "partially coupled" basis functions, instead of traditional "uncoupled" (determinantal) or "coupled" basis functions, and may provide a simpler method for calculating configuration mixing in highly excited states of very complex

atoms or for calculating nuclear shell-model energies. (auth)

34882 EXACT CALCULATION OF K-SHELL AND L-SHELL PHOTOEFFECT. Alling, W. R.; Johnson, W. R. (Univ. of Notre Dame, Ind.). Phys. Rev., 139: 1050-62 (Aug. 16, 1965). (COO-427-45)

An exact calculation of the atomic photoelectric effect is made. The expressions for the differential and total cross sections are developed explicitly for the K and L shells, for a pure Coulomb potential. The final electron is described by a partial-wave decomposition and the interaction with the radiation field is treated in lowest order perturbation theory. The cross sections are evaluated numerically, and the contribution of the L shell is found to be non-negligible when compared with the K shell. The results for the K shell are compared with previous work, and agreement is obtained. The new results for the L subshells are presented and compared with the available experimental work. (auth)

34883 DISSOCIATION OF MOLECULAR HYDROGEN IONS ENHANCED BY ION-SOURCE OPERATION. Chambers, E. S. (Univ. of California, Livermore). Phys. Rev., 139: 1068-71(Aug. 16, 1965). (UCRL-7946(Rev. 2))

The cross section for the dissociation reaction $H_3^+ + H_2 \rightarrow H_2^+ + H + H_2$ increased by a factor of about 4 when the r-f ion-source magnet field was raised. This increase is attributed to H_3^+ ions in high vibrational states. The energy dependence of the cross section was measured. Excited ions increased from 6 Å² at 5 kev to 10 Å² at 50 kev, whereas the normal ions increased from 1.5 to 2.5 Å² over the same energy range. The companion reaction cross section, for H_3^+ producing H^+, was 0.5 Å² at 5 kev increasing to 1.6 Å at 35 kev. Cross sections were about 0.25 Å² higher for excited ions than for normal ions. The cross section for dissociation of H_3^+ to H^+ was about 1.6 Å² from 5 to 45 kev. H_3^+ was detected; its dissociation to H^+ with one-fifth the energy gave a cross section of 3.2 Å² at 20 kev, independent of source condition. Excited H_3^+ may be a useful ion for transverse injection into a magnetically confined plasma. (auth)

34884 SPUTTERING OF A CATHODE IN ARC ION SOURCE. Pasyuk, A. S.; Tretyakov, Yu. P.; Stanku, V. (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 3, 42-5(May-June 1965). (In Russian)

The effect of the operating conditions of an arc ion source with oscillating discharge on the rate of cathode sputtering was investigated. Sputtering of a W cathode by such a source occurs basically as the result of bombardment by W ions (self-sputtering). The rate of cathode sputtering is proportional to the current strength of the arc and to the square of the discharge voltage and depends very little on the type of gas supplied in the source. (tr-auth)

34885 ELECTRON CAPTURE FROM ATOMIC HYDROGEN BY ALPHA PARTICLES AND PROTONS. Coleman, J. P.; McDowell, R. C. (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 85: 1097-1108(June 1965).

Cross sections for electron capture from the ground state of atomic hydrogen into final 1s, 2s, $2p_x$, and $2p_z$ states of H and He^+ by protons and alpha particles respectively are calculated in a second Born approximation, for a model problem in which there is no interaction between the heavy particles and the intermediate states are restricted to lie in the continuum. (auth)

34886 ELECTRON CAPTURE FROM ATOMIC NITROGEN AND OXYGEN BY PROTONS. Mapleton, R. A. (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 85: 1109-20(June 1965).

OBK cross sections were previously defined and calculated for $H^+ + A(^{2S+1}L) \rightarrow H(1s,2s) + A^+(^{2S'+1}L')$ using the atomic orbitals calculated by Tubis. The atomic orbitals of Roothaan and Kelly are used in a more extensive calculation of these OBK cross sections for impact energies from 15 kev to 10 Mev. The cross sections are evaluated for the following cases: A = $O(^3P; 2p^4)$: $A^+ = O^+(^4P, ^2P; 2s2p^4)$ and A = $N(^4S; 2p^3)$: $A^+ = N^+(^3P; 2p^2)$, $A^+ = N^+(^5S, ^3S; 2s2p^3)$. In the important cases of p-orbital capture, the new cross sections are less than the former values from 100 to 900 kev, and larger elsewhere. The old values do not exceed the new values by more than 30%. A comparison of the cross sections for 2p- and 2s-orbital capture shows that 2s capture is dominant for impact energies in excess of several Mev, and that 2s capture is not negligible at all lower impact energies. The definition of the OBK cross section is extended to include electron capture between single-charged, many-electron ions and atoms. The Born prior and post cross sections are evaluated using Tubis orbitals for capture into H(1s) for A = $O(^3P; 2p^4)$, $A^+ = O^+(^4S; 2p^3)$. Although the energy dependence is not radically different from the Born estimates obtained using the ratios R(H; He) and the author's OBK cross sections, the magnitudes exceed the OBK values for impact energies less than 1 Mev. These Born cross sections are asymptotically equal to 0.592 $Q_{BK}(^4S)$ at high impact energies. (auth)

34887 IMPACT IONIZATION OF SODIUM. Bates, D. R.; Boyd, Anne H.; Prasad, S. S. (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 85: 1121-6(June 1965).

The cross sections for Na(3s) + X → Na^+ + e + X, in which X is a proton or an electron, are calculated by the first Born approximation. In the proton case the cross section obtained passes through a maximum of 1.9×10^{-15} cm² at an impact energy of 7.6 kev, and in the electron case it passes through a maximum 5.6×10^{-16} cm² at an impact energy of 14 ev. (auth)

34888 ON THE PERTURBATION TREATMENT OF THE ONE-ELECTRON DIATOMIC MOLECULAR ION. Bailey, P. B. (Sandia Lab., Albuquerque, N. Mex.). Proc. Phys. Soc. (London), 85: 1127-31(June 1965).

The approximating expressions for the electronic energy levels of the ion as a function of the internuclear separation R, which have been obtained by Dalgarno and Lewis and by Robinson, should be expected to be good for large R but not for small R. By adopting a slightly different point of view new formulas can be obtained for small R. (auth)

34889 IONIZATION OF LIQUID ARGON BY α PARTICLES. Swan, D. W. (London Univ.). Proc. Phys. Soc. (London), 85: 1297-1302(June 1965).

From an analysis of electron pulses in liquid argon produced by α particles the average energy required to form an ion pair is evaluated, assuming Jaffé's theory of columnar recombination is valid. The mean value of 26.0 ev found in this way agrees well with the corresponding value of 26.4 ev for α particles in argon gas. Application of Jaffé's theory to the liquid state is discussed, and from the pulse distributions it is established that the experimental results are in good agreement with this theory. (auth)

34890 THE GROUND STATE OF THE HYDROGEN MOLECULE. Flannery, M. R. (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 85: 1318(June 1965).

Weinbaum's treatment of the $^1\Sigma_g^+$ state of H_2 is adapted to calculate the ground state electronic wave function at several internuclear distances. (auth)

34891 SIMULTANEOUS VELOCITY SELECTION OF CROSSED MOLECULAR BEAMS. Colgate, S. O.; Imeson, T. C. (Univ. of Florida, Gainesville). Rev. Sci. Instr., 36: 932-40(July 1965).

A metallic, horizontal disk mechanical velocity selector suitable for studying scattering at the intersection of two monoenergetic molecular beams has been constructed and tested. Principles of the design, construction, and operation are presented along with detailed calculations of the transmission characteristics for both narrow and divergent beams. The calculations are in good agreement with measurements of the transmitted intensities of beams of cesium atoms effusing from an oven at 405°K. (auth)

34892 APPLICATION OF THE QUANTUM ATTENUATION THEORY FOR RESOLVING CERTAIN PROBLEMS RELATED TO DISSOCIATION. Dubrovskii, G. V. Vestn. Leningr. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 43-8(1965). (In Russian)

The problem of the intersection of the discrete spectrum with continuum is discussed in the light of the theory of quasi-stationary state decay. As an example, the formula for cross section has been established for the processes: $e + A_2 \rightarrow A + A^-$, and $e + A_2^+ \rightarrow A + A^*$. This general formula, which was derived using the perturbation theory, is compared to the other results and is found suitable for the numerical calculations. (auth)

34893 MATRICES FOR ELECTROSTATIC INTERACTIONS OF d^n sp CONFIGURATIONS. Yakubovskii, O. A. Vestn. Leningr. Univ., No. 1, Ser. Mat., Mekhan. i Astron., No. 1, 147-50(1965). (In Russian)

The formula by which energy matrices of configurations d^nsp can be obtained using the results of calculations of d^ns and d^np are derived. (auth)

34894 ATOMS, MOLECULES AND QUANTA. Second Revised Edition. Volume I. Ruark, Arthur Edward; Urey, Harold Clayton. Dover Books on Physics and Mathematical Physics. New York, Dover Publications, Inc., 1964. pp 1-447. $2.50.

A presentation is made of the mathematical and physical relations, laws, and observations concerning atoms, molecules, and quanta, with emphasis placed on their spectra. Other topics include quantum theory and dynamical principles. (J.F.P.)

34895 ATOMS, MOLECULES AND QUANTA. Second Revised Edition. Volume II. Ruark, Arthur Edward; Urey, Harold Clayton. Dover Books on Intermediate and Advanced Mathematics. New York, Dover Publications, Inc., 1964. pp 448-810. $2.50.

A mathematical and physical treatment is given to atoms, molecules, and quanta. Material presented includes critical potentials of atoms and molecules, wave mechanics, matrix mechanics, quantum dynamics, and spectral intensities. (J.F.P.)

Cosmic Radiation

See also Elementary Particles and Radiations. Nuclear Properties and Reactions.

Refer also to abstracts 35247, 35260, 35266, and 35445.

34896 (N64-27821) MARINER A PLASMA PROBE. Technical Report No. 337. Bridge, H. S.; Rossi, B.; Scherb, F.; Baker, R. H.; Cuikay, R. S.; Lyon III, E. F. (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). Dec. 5, 1963. 62p. (NASA-CR-56794). $6.60(CFSTI).

The purpose and function of plasma instrumentation designed and built for use with the Mariner A spacecraft are described. The equipment determines the particle number density and energy spectra of plasma protons and electrons and the direction of motion of the plasma. The basic sensor unit is a faraday cup that measures a current produced by the proton or electron component of the plasma. The electronic circuits that operate the sensors are discussed in detail. The measurement link receives a modulated signal (10^{-12} to 10^{-7} amp at 2kc) from the faraday cup collector and amplifers and compresses and demodulates it to present a d-c output signal to the spacecraft data automation system. The high-voltage supply contains a modulator that produces a 2-kc square wave of variable amplitude (approximately 10 to 3,000 v), which is applied to the faraday cup grids. The sequence of operations in a measurement cycle is controlled by the logic circuit, which is in turn controlled by the spacecraft data automation system. (auth)

34897 (JPRS-30352) COSMIC-RAY VARIATIONS. Dorman, L. Translated from Nauka i Zhizn, No. 2, 80-5 (Feb. 1965). 13p. (TT-65-31133) $1.00(CFSTI).

Worldwide activities in recording cosmic-ray variations are mentioned. Cosmic-ray intensity variations caused by changes in the earth's atmosphere, by changes in the earth's magnetic field, and by extraterrestrial variations are discussed. The extraterrestrial variations, due to solar-activity modulation of galactic cosmic rays, solar generation of cosmic rays, and generation and propagation of galactic and metagalactic cosmic rays, are further examined. (M.J.T.)

34898 ASTRONOMICAL OBSERVATIONS FROM SPACE VEHICLES: UPPER LIMITS TO THE FLUX OF HIGH ENERGY γ-RAYS FROM SELECTED QUASI-STELLAR AND OTHER SOURCES, USING THE ČERENKOV TECHNIQUE. Long, C. D. (University Coll., Dublin); Porter, N. A.; Weekes, T. C.; Fruin, J. F.; Jelley, J. V. Ann. Astrophys., 28: 263-4(1965).

An investigation is summarized in which an attempt was made to detect gamma rays with energies $\geq 5 \times 10^{12}$ ev from five celestial objects by detecting the Cherenkov emission of secondary charged particles in cosmic showers produced by the high-energy gamma rays. Upper limits on the gamma fluxes in this energy region were established for the quasi-stellar sources 3c 147, 3c 196, 3c 273; the Crab Nebula; and the magnetic variable 53 Cam. All the flux limits are of the order of 10^{-10} photons cm^{-2} sec^{-1}. Corresponding upper energy limits at emission are $\sim 5 \times 10^{47}$ erg sec^{-1} for the quasi-stellar sources and 5×10^{35} erg sec^{-1} for the Crab Nebula, if gamma absorption is assumed to be negligible. Possible absorption mechanisms are discussed. (D.C.W.)

34899 COSMIC RAYS AND PARTICLES OF NEGATIVE MASS. Terletskii, Yakov P. (Moscow State Univ.). Ann. Inst. Henri Poincare, Sect. A, 1: 431-6(1964).

The possible mechanism of acceleration of cosmic ray particles effected by their interaction with a hypothetical heat reservoir of negative temperature is discussed. The heat reservoir is considered as consisting of negative mass particles. The observed energy spectrum of the primary cosmic ray component can be explained if the following three assumptions are made: the mean metagalactic densities of the negative mass particles and positive mass particles are of the same order of magnitude, the constants of interaction between negative mass and positive mass particles, and the constants of interaction between positive mass and positive mass particles, are of the same order of magnitude, the primary component has a metagalactic origin. The proposed mechanism in general, may account for the acceleration of relativistic particles in regions of their higher density. It is possible that a new energetic cosmic source may operate according to this mechanism. (auth)

34900 AVERAGING INTERVALS IN CALCULATING METEOROLOGICAL CORRECTIONS OF COSMIC-RAY INTENSITY. Kavlakov, S. Compt. Rend. Acad. Bulgare Sci., 16: 593-6(1963).

The dependence is studied between the correlation and regression coefficients in the interval in which the corresponding magnitudes have been averaged. On the basis of various experimental data, it is shown that at the meteorological corrections of cosmic ray intensity the correlation coefficients grow in absolute values with the increase of that interval, while the regression coefficients do not change substantially. (auth)

34901 DIFFUSION MECHANISM OF DIURNAL COSMIC-RAY VARIATIONS. Krymskii, G. F. (Inst. of Research in Cosmic Physics and Aeronomy, Academy of Sciences, Siberian SSR). Geomagnetism Aeronomy (USSR)(English Transl.), 4: 763-9(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 977-(1964).

The formation of cosmic-ray anisotropy under the effect

of the solar wind is examined. It is shown that if the magnetic field has a uniform component there must be anisotropy with a maximum at a right angle to the east of the sun. The amplitude of the anisotropy is computed as a function of wind velocity and the degree of irregularity of the magnetic field, which is characterized by the ratio of the transverse coefficient of cosmic-ray diffusion to the longitudinal coefficient. Consideration of the induced electric field and the deceleration of cosmic rays in the wind shows that there will be no anisotropy in the case of a spherical wind with an irregular isotropic magnetic field. If the wind is bounded by low solar latitudes, there must be an anisotropy of cosmic rays with a maximum in the direction of the sun. (auth)

34902 SOME CHARACTERISTICS OF COSMIC-RAY ANISOTROPY DURING GEOMAGNETIC STORMS. Dorman, L. I.; Inozemtseva, O. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR)(English Transl.), 4: 862-5(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1113-(1964).

An analysis of the diurnal anisotropy and the effect of the increase in the cosmic-ray intensity during a magnetic storm on Oct. 25, 1960 is summarized. The storm had a sudden commencement, but apparently was not accompanied by a Forbush effect. The results indicate that the Forbush effect was masked by the effect of the increase in cosmic-ray intensity. (D.C.W.)

34903 IRREGULAR VARIATIONS IN THE INTENSITY OF THE NEUTRON COMPONENT OF COSMIC RAYS, CAUSED BY A TEMPERATURE EFFECT. Kaminer, N. S.; Ilgach, S. F.; Khadakhanova, T. S. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR and Irkutsk State Univ., USSR). Geomagnetism Aeronomy (USSR)(English Transl.), 4: 865-6(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1116-(1964).

An investigation of irregular variations in the neutron component of cosmic radiation, due to atmospheric temperature variations, is summarized. The results support previous findings that the temperature effect in the neutron component has a negative sign and reaches a considerable magnitude. (D.C.W.)

34904 MOMENTUM SPECTRA OF π MESONS PRODUCED BY NUCLEON INTERACTIONS AT ENERGIES OF SEVERAL HUNDRED Bev. Dobrotin, N. A.; Zelevinskaya, N. G.; Maksimenko, V. M.; Puchkov, V. S.; Slavatinskii, S. A. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 1751-4(Nov. 1964). (In Russian)

Momentum spectra of π-mesons produced by nucleon interactions at 100 to 400 Bev were measured in the Pamir station at 3860 m elevation. The curves of the angular distribution of particles for 260 showers plotted for laboratory and mirror coordinates were in good agreement. The momentum spectrum of π-meson production in the mirror coordinate system developed by means of a Wilson chamber in a magnetic field combined with ionization calorimeter and calculated by the Planck formula $kT = 0.65\ \mu c^2$ showed only 5 particles with pulse >12 Bev/c while the experimental data indicated 36 particles. An attempt was made to determine the possible production of high-energy π mesons by decay of nucleon isobar states. The studies were carried out by selecting π meson with momentum and angle of emission satisfying the kinematic scattering of known nucleon isobars. Thirty nine such mesons were found. The obtained mean meson value $(p_{\perp}^{\pi}) = 0.7$ Bev/c meant that the anticipated transverse nucleon pulse from the isobar is $\langle p_{\perp}^{N} \rangle = 1$ to 2 Bev/c. The calculations found about 2 mesons per shower with the mean energy equal to 10% of the initial particle. Consequently, the coefficient of inelasticity should be divided into two components $k = k_{isobar} + k_{FB}$. (R.V.J.)

34905 INELASTICITY COEFFICIENT OF COSMIC PARTICLE INTERACTIONS AT ENERGIES OF SEVERAL HUNDRED Bev. Kotel'nikov, K. A. (Lebedev Inst. of Phys., Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 1755-7(Nov. 1964). (In Russian)

The data on 32 interactions at $E_0 \gtrsim 100$ Bev collected at the Pamir station were used in the analysis of the works which indicated a small dependence of the mean elasticity coefficient (K_{lab}) on the E_0 energy of primary particles and of the work carried out with a Wilson chamber in a magnetic field and with nuclear emulsions, which indicated a strong dependence of the (K_{lab}) on the γ_c. The function found in these works was written as $(K_{lab}) \approx 1/\gamma_c\alpha$ (where γ_c is the Lorentz factor of the cms of colliding nucleons determined with the assumption of symmetric scattering of the secondary particles the α magnitude is equal to unity.) The magnitudes of the inelasticity coefficient in laboratory coordinate system and mirror system $(K_{lab'}) \approx (K_{mirror}) \approx 1/\gamma_\mu$ did not indicate a strong dependence of the mean inelasticity coefficient on the energy of primary particles. (R.V.J.)

34906 ANALYSIS OF ANGULAR DISTRIBUTIONS OF SECONDARY PARTICLES IN HIGH-ENERGY NUCLEAR INTERACTIONS IN PHOTOEMULSIONS. Zhdanov, G. B. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 1764-6(Nov. 1964). (In Russian)

Under ordinary conditions in photoemulsion experiments in which the energy of the primary particle is unknown it is possible to determine only so called mirror coefficients of inelasticity (K_{mirror}). A model of two isotropically decaying meson clouds (fireballs) was used for determining the angular distribution of produced particles. The concept of fireballs was studied by measuring the ratio of $\epsilon_\gamma / \epsilon_{charge}$ (where ϵ charge the energy emitted into charged particle and ϵ_γ is the energy emitted in electron-photon cascades). (R.V.J.)

34907 AMOUNT OF ENERGY TRANSMITTED TO THE SOFT COMPONENT BY PARTICLES INTERACTING WITH CARBON NUCLEI. Azimov, S. A.; Polyak, Yu. V.; Abudellaev, R. S. (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 1776-7 (Nov. 1964). (In Russian)

Measurements were conducted at the mountain station of the Uzbek Academy of Sciences. The station is 3170 meters above sea level. The apparatus was operated for 600 hours. It consisted of 11 series of ionization chambers (150 in all) and three series of hodoscope counters (240 in all) placed between layers of graphite, lead, and iron. Each counter was connected to an individual amplifier. All energy yields of more than 100 Bev were recorded. The average coefficient of energy transfer to the electron-photon component was determined to be 0.29 ± 0.06. (ATD)

34908 FLUCTUATION CURVES IN INTERACTIONS OF NUCLEAR-ACTIVE PARTICLES IN COSMIC-RAY PROCESSES AT HIGH ENERGIES. Grigorov, N. L.; Shestoperov, V. Ya. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 1778-83(Nov. 1964). (In Russian)

The anticipated intensity and energy spectra for γ quanta, mesons(μ), young atmospheric showers, and ionization bursts were calculated in order to determine the processes responsible for the fluctuations in particle interactions as high energies. The characteristics of wide atmospheric showers were also estimated. The calculations were carried out assuming that during nucleon reactions with nuclei, the atmospheric pions are produced with a spectrum corresponding to isotropic decay of a fireball slowly moving in the center of mass system of colliding nucleons (so called pionization reaction) and that in the reactions with the coefficient of inelasticity equal to unity, nearly, 80% of the primary particle energy is transmitted to the small number of one sort (charged or neutral) pions (so called catastrophic reactions). The results of the analysis showed that due to the sharp spectral incidence of nuclear active particles and small mean energy of secondary particles the pionization processes play a negligible part in the high and super high energy cosmic processes. The reactions with the catastrophic energy losses play the main part in the high-energy processes. (R.V.J.)

34909 INELASTIC INTERACTIONS OF PROTONS AND π MESONS WITH NUCLEAR EMULSION NUCLEONS AT ENERGIES OF 7 TO 20 Bev. Boos, E. G.; Botvin, V. A.; Vinitskii, A. Kh.; Takibaev, Zh. S.; Chasnikov, I. Ya. (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 1770-2 (Nov. 1964). (In Russian)

Inelastic interactions of protons and mesons(π) with nucleons were measured in nuclear emulsion at 7 to 20 Bev. Sixty five two prong interactions were used in the analysis of pp interactions at 9 Bev. The angular distribution of protons and π mesons in the center-of-mass system are symmetric. The distribution of the inelasticity coefficient showed a tendency to have two maxima. The mean value of energy carried out by a charged π meson in the cms practically does not depend on the type of reaction and is equal to (17.6 ± 0.9)%. A total of 200 inelastic πN interactions were examined. The momentum distribution of the secondary charged pions in the cms had a tendency to form two peaks at p ≈ 0.3 and 0.7 Bev/c. However in the total distribution these peaks were not observed. It is shown that the protons in π^-p interactions carry away more energy than the protons in $\pi\mu$ interactions. (R.V.J.)

34910 PRODUCTION OF π^0 MESONS AT PARTICLE ENERGY OF 5×10^{12} TO 10^{13} ev. Babayan, Kh. P.; Brikker, S. I.; Grigorov, N. L.; Podgurskaya, A. V.; Savel'eva, A. I.; Shestoperov, V. Ya. (Moscow State Univ. and Inst. of Physics, State Committee on Utilization of Atomic Energy, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 1784-9(Nov. 1964). (In Russian)

A method of "controlled nuclear photoemulsions" was used for determining the singular properties of meson(π^0) production in high-energy particle production by strong ionization bursts. The method was based on nuclear emulsions interlayed with lead filters placed over an installation with a large number of ionization chambers. The ionization chambers determined electron-photon shower coordinates passing through the nuclear photoemulsion, measured the total energy transmitted to the mesons(π^0) by nuclear active particles in the 210 g cm^{-2} graphite, and determined the primary particle energy E_0. The ionization chambers revealed six showers with $E_{\pi^0} \geq 2 \times 10^{12}$ ev. The energy transmitted to π^0 mesons, $K_{\pi^0} = \Sigma E_\gamma / E_0$, the number of π^0 mesons n_{π^0}, and the energy of the maximum energy π^0 meson $E_{\pi max}$ were determined for each shower. The tabulated results showed that in such interactions the greatest number of ionization bursts appears when the coefficient of inelasticity is close to unity and 80% of primary particle energy is transmitted to mesons(π); the generated multiplicity of mesons(π^0) is $\bar{n}_{\pi^0} \approx 4$ and considerably less than the mean multiplicity at corresponding primary particle energy. (R.V.J.)

34911 PRODUCTION OF ELECTRON-PHOTON COMPONENT BY NUCLEON-NUCLEON COLLISIONS. Murzin, V. S. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 1790-3(Nov. 1964). (In Russian)

The ratio of the electron-photon component energy and the energy of charged mesons was studied in order to determine some new sources of photon production, the singularities of strong interactions at high energies and to confirm the ratios $K = 3\alpha_{\pi^0}$ and $K = 1.5\ \alpha_{\pi^\pm}$ which can be used as a base for determining total coefficients of inelasticity. (R.V.J.)

34912 NUCLEAR-ACTIVE PARTICLES OF COSMIC RAYS AT HIGH MOUNTAIN ELEVATION AND THEIR REACTIONS WITH CARBON NUCLEI. Alekseeva, K. I.; Grigorov, N. L.; Erofeeva, I. N.; Mishchenko, L. G.; Murzin, V. S.; Rapoport, I. D.; Sarycheva, L. I.; Sobinyakov, V. A.; Titenkov, A. F. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 1794-7(Nov. 1964). (In Russian)

Reactions of nuclear-active particles with carbon nuclei were studied at 3260 m elevation using an ionization calorimeter consisting of 12 ionization counters with a flat Wilson Chamber. The latter was used for determining the place of nuclear-active particle interactions in one of the filters (12 cm graphite, 4 cm iron, and 1.5 cm aluminum cover) and also for determining angular distributions of secondary charged particles. Three rows of hadoscope counters at the upper part of the installation were used for determining the charge of the incident single nuclear-active particles, for separating the nuclear-active particles in the atmosphere shower, and for uncovering showers in the upper lead filter. The lead filter was capable of retaining electrons and photons incident on the installation from the atmosphere. The selection of events was carried out by separating energies in the calorimeter. One ionization chamber was capable of measuring ionization corresponding to the passage of 20 to 10,000 relativistic particles. The curve of $\alpha_\gamma(E_0)$ as a differential function of interactions in iron showed that with E_0 close to the threshold, the events with large α_γ value prevail. The angular distribution of the secondary particle in the coordinate gravity center of two colliding nucleons in graphite was determined. Correlations of the Lorentz factor γ_c, determined with the ionizing calorimeter and γ_c^0 determined by Castigliano formula indicated that nucleon-nucleon collisions take place during interactions with graphite nuclei. Only two events with γ_c and γ_c^0 differing by a factor of 2 was observed. (R.V.J.)

34913 COMPOSITION OF THE NUCLEAR-ACTIVE PARTICLE FLUX OF THE COSMIC RADIATION AT 3250 m ELEVATION. Khrimyan, A. V.; Avakyan, V. V.; Pleshko, M. P.; Khrimyan, G. V. (Inst. of Physics, State Committee on Utilization of Atomic Energy, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 1803-6(Nov. 1964). (In Russian)

The composition of nuclear-active particle flux as a momentum range of >2 Bev/c was studied in order to determine the properties and spectra of particles produced by cosmic rays. The mean square error in determination of momentum of 200 to 2000 Mev/c was 2 to 10 and 10% for mesons(π) and protons, respectively. The ionizing ability of various particles was determined with the order of accuracy of ±14% (by five-layer proportional gas counter) and 10% (by five scintillation counters). The results of direct measurements in three filters showed that at the momentum range from 480 to 900 Mev/c the nuclear-active particles contain ~5% protons; at the momentum range from 240 to 720 Mev less than 0.2% of mesons(K), at 720 to 900 Mev/c about 1% of mesons(K). Measurements carried out on the basis of all available data indicated that at 700 to 2000 Mev/c the nuclear-active particles contained ~3% deuterons, at ≥ 800 Mev/c. (R.V.J.)

34914 A NEW METHOD FOR INVESTIGATING THE PRODUCTION OF HEAVY PARTICLES IN THE COSMIC RADIATION. Damgaard, G.; Grieder, P.; Hansen, K. H.; Iversen, C.; Lohse, E.; Peters, B.; Rengarajan, T. (Universitet, Copenhagen). Phys. Letters, 17: 152-4(July 1, 1965).

A set of experiments are discussed which make it possible to study the cosmic ray induced flux and the properties of heavy, strongly or weakly interacting particles in the atmosphere or alternatively put a fairly low upper limit on their occurrence. Such strongly interacting particles and weakly interacting particles if charged will be referred to as plutons. From a consideration of the properties of plutons it is concluded that a particle arriving with more than 10 Bev and delayed by more than 50 nsec, has a mass greater than the nucleon and is therefore a pluton. An experiment based on these considerations was set up. It consisted of a threefold coincidence meson (μ) telescope employing plastic and liquid scintillators. Thus far a crude upper limit is set on the flux of plutons. (J.F.P.)

34915 SPECTRUM OF SMALL BURSTS CREATED BY μ-MESONS AT THE DEPTH OF 200m w.e. UNDERGROUND. Bibilashvili, M. F.; Barnaveli, T. T.; Grubelashvili, G. A.; Muradova, N. A. (Inst. of Physics, Academy of Sciences, Tbilissi, USSR). Phys. Letters, 17: 175-6(July 1, 1965).

A spark calorimeter was found to be advantageous in the detection of small bursts created by mesons (μ). Such a calorimeter containing five rows of spark chambers separated with lead filters was placed underground at a depth of 200 mwe. Each chamber was filled with neon of high purity at a pressure of one atmosphere. The obtained integral spectrum of bursts can be described by an exponential law with the exponent $\gamma = -2.3^{+0.4}_{-0.3}$. (J.F.P.)

34916 IONIZING RADIATION MEASURED BETWEEN EARTH AND VENUS BY MARINER 2. Anderson, H. R. (Jet Propulsion Lab., Pasadena, Calif.). Proc. Intern. Space Sci. Symp., 1964, 5: 521-43(1965).

An ionization chamber and two G–M tubes on Mariner 2 measured the ionization rate and average omnidirectional flux of interplanetary radiation during September–December 1962 at distances of 1.0 to 0.71 A.U. from the sun and 0.55 to 80.2 × 10^6 km from the earth. The ion chamber and one G–M tube were shielded with 0.2 g/cm^2 of Fe, and the second G–M tube with 0.11 g/cm^2 of Be so that protons with E > 10 Mev and electrons with E $\gtrsim$ 0.5 Mev penetrated all detectors. The two G–M tubes' response to x rays and nonpenetrating electrons differed. Near the earth the ionization rate averaged 667 ion pairs/(sec cm^3 of STP air) and both G–M tubes measured about 2.9 particles/cm^2 sec. It is concluded that only penetrating particles were detected. Their average specific ionization is 2.9 times minimum, which is consistent with measured charge and energy spectra of galactic cosmic radiation. Within 14 × 10^6 km of earth, variations of flux and ionization rate correlate strongly with the Deep River neutron monitor rate; the mean ratio of changes is 2.3. The correlation coefficient declined from 0.64 to 0.02 at distances of 14 to 55 × 10^6 km from the earth but returned to 0.80 at distances from 55 to 81 × 10^6 km. The neutron monitor data and the ratio 2.3 are used to compute ionization rate and flux near earth during the mission, and the solar radial gradient of radiation is calculated from the difference between these values and those measured at the spacecraft. Gradients were obtained of 9.3 per cent/A.U. in ion rate and 0 percent/A.U. in flux at 0.81 to 0.72 A.U. from the sun, but at 0.72 to 0.70 A.U. –2.6 per cent/A.U. and –17.9 per cent/A.U. are computed. (auth)

34917 SOLAR FLARE X-RAY EMISSION MEASUREMENTS AND PLASMA OBSERVATIONS AT 10^5 km. Conner, J. P.; Evans, W. D.; Montgomery, M. D.; Singer, S.; Stogsdill, E. E. (and others) (Los Alamos Scientific Lab., N. Mex.). Proc. Intern. Space Sci. Symp., 1964, 5: 546-63 (1965).

In the fall of 1963 a set of instruments which included scintillation x-ray detectors was launched on each of two satellites into approximately circular orbits of about 10^5 km radius. Thin scintillation screens and two different filter thicknesses were used on different detectors to get two different spectral sensitivity bands below 10 Å. The detectors are also sensitive to charged particles: however, it is possible to differentiate between x rays and charged particles from the characteristics of the signals. During the period of relatively high solar activity from October 17 to November 1, 1963, the satellites transmitted continuously and simultaneously about 70 percent of the time; and many signals due to x rays were observed. Since November 1, the frequency of occurrence of detectable signals has been much less. Many but not all the x-ray signals are correlated with reported solar flares. Usually signals in the thin-filter detectors preceded those in the thick-filtered detectors by several minutes; however, in some cases both kinds of detectors responded at the same time. Also observed was the fact that x-ray emission intensity varies considerably for flares of the same class, and flares of different classes may produce the same x-ray intensity. Charged particles can produce signals in these detectors either by penetration of the filters and deposition of energy directly in the scintillator, or by the production of bremsstrahlung in the filter material. During the first few months of operation, numerous detector signal events have been observed which are believed to be caused by plasma clouds containing electrons of energy greater than 60 kev. Most observations of plasma have occurred when the spacecraft was nearly opposite the sun. After February 1964, signals were frequently seen when the sun-earth-vehicle angle was between 100 and 150°; these may correspond to the fluxes of electrons with energy >40 kev seen by Explorers 12 and 14. (auth)

34918 A STUDY OF COSMIC RAYS AT ALTITUDES OF 200 TO 400 km. Vernov, S. N.; Savenko, I. A.; Shavrin, P. I.; Nesterov, V. E.; Pisarenko, N. F.; Basilova, R. N. (Academy of Sciences, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 575-82(1965).

Time variations and geographic distribution of the intensity of radiation recorded at altitudes of 200 to 300 km by the STS-5 counter are studied. Analysis of the STS-5 counting rate shows that the change of counting rate with time is similar to the change observed for cosmic rays in the stratosphere. Consideration of the geographic distribution of the STS-5 counting rate reveals a single-valued relationship between the counting rate and the threshold magnetic rigidity of an observation point. (auth)

34919 CHARGE AND ENERGY SPECTRA OF Z < 3 PRIMARY AND SECONDARY COSMIC RAYS AT 46° GEOMAGNETIC LATITUDE. Koch, L.; Engelmann, J.; Labeyrie, J.; De Zertucha, D. (Centre d'Etudes Nucleaires, Saclay, France). Proc. Intern. Space Sci. Symp., 1964, 5: 583-9(1965).

The results of two 1964 experiments by means of a balloon borne apparatus are given. The detector consisted of a solid dE/dx telescope whose aperture was 0.5 cm^2 steradian. From the spectra registered during the ascent and the ceiling flight the flux values of the primary particles deduced for rigidity greater than 4.7 Bev/c are 830 ± 160 protons m^{-2} sterad^{-1} sec^{-1} and 160 ± 40 alphas m^{-2} sterad^{-1} sec^{-1}. Moreover, the secondary electron flux (for energies greater than 1.8 Mev) is found to be maximum for an atmospheric depth of 200 g/cm^2; the value of this maximum is 2500 electrons m^{-2} sterad^{-1} sec^{-1}. (auth)

34920 GALACTIC COSMIC RAYS IN THE INTERPLANETARY MEDIUM. Axford, W. I. (Cornell Univ., Ithaca, N. Y.). Proc. Intern. Space Sci. Symp. 1964, 5: 612-15(1965).

A simple model which takes account of the convection and diffusion of galactic cosmic rays in the interplanetary medium is described. It is found that the joint effects of radially moving scattering centers, and a roughly garden hose magnetic field configuration near the sun, provides a basis for understanding both the eleven-year and the diurnal cosmic ray variations. Interesting implications of the model are that the solar wind may be affected by the presence of a radial cosmic ray pressure gradient, and that the intensity of cosmic rays in the galaxy may be significantly larger than observed on the earth, even at sunspot minimum. (auth)

34921 AN ESTIMATE OF THE CONTRIBUTION FROM REENTRANT ALBEDO TO THE MEASUREMENT OF PRIMARY ELECTRONS. Bland, C. J. (Universita, Milan). Proc. Intern. Space Sci. Symp., 1964, 5: 618-24(1965).

Recent experiments have indicated the existence of a flux of primary electrons in the cosmic radiation. The contribution of reentrant albedo io these measurements is, however, unknown. Assuming that such albedo could derive from steeply inclined air showers, an estimate was made of the number of reentrant albedo electrons that would arrive at balloon altitudes at a geomagnetic latitude of 45°. It is concluded that the measured fluxes are much higher than the albedo that could arise from this mechanism, and that such measurements, after correction for secondaries, must represent a primary flux. (auth)

34922 NRL SOLAR RADIATION MONITORING SATELLITE: DESCRIPTION OF INSTRUMENTATION AND PRELIMINARY RESULTS. Kreplin, R. W. (Naval Research Lab., Washington, D. C.). Proc. Intern. Space Sci. Symp., 1964, 5: 951-65(1965).

A solar x-ray monitoring satellite was launched in January 1964. It is equipped with ionization chambers to cover the ranges 1-8 Å, 8-12 Å, and 44-60 Å. Data are transmitted in real time on 136 Mc per second and several European observatories have successfully recorded the telemetry. The orbit is nearly circular at 900 km and each pass provides 10 to 20 minutes of data at a ground station. In January and February, the observed x-ray flux was as low as the minimum measured by rockets during the last sunspot minimum period in 1953 and 1954. At 1 to 8 Å, there was no detectable emission in excess of 10^{-4} erg cm^{-2} sec^{-1} in the absence of solar flares. In the 8 to 12 Å band, the flux has averaged about 4×10^{-4} erg cm^{-2} sec^{-1}; at 44 to 60 Å, the average flux has been about 2.5×10^{-3} erg cm^{-2} sec^{-1}. (auth)

34923 INTERNATIONAL CONFERENCE ON COSMIC RAYS, JAIPUR, DECEMBER 2-14, 1963, PROCEEDINGS. VOLUME 3. COMPOSITION, ORIGIN AND PRE-HISTORY. Under the Auspices of The International Union of Pure and Applied Physics and The Department of Atomic Energy, Government of India. Daniel, R. R.; Lavakare, P. J.; Menon, M. G. K.; Naranan, S.; Nerurkar, N. W.; Pal, Yash; Sreekantan, B. V., eds. Bombay, The Commercial Printing Press Limited, 1964. 525p. Available from Tata Inst. of Fundamental Research, Bombay. (CONF-320)

Separate abstracts were prepared for 42 of the 51 papers included. The remaining papers were previously abstracted for NSA (16: 9342; 18: 4413, 10815, 20815, 30377, 30435, 30436, 44400; and 19: 20882). (D.C.W.)

For abstracts of individual papers see: 34376, 34579, 34924, 34925, 34926, 34927, 34928, 34929, 34930, 34931, 34932, 34933, 34934, 34935, 34936, 34937, 34938, 34939, 34940, 34941, 34942, 34943, 34944, 34945, 34946, 34947, 34948, 34949, 34950, 34951, 34952, 34953, 34954, 34955, 34956, 34957, 34958, 34959, 34960, 34961, 34962, and 34963.

34924 LIGHT, MEDIUM AND HEAVY NUCLEI IN THE PRIMARY SPECTRUM IN 1963 AT MINNEAPOLIS. Weber, W. R.; Ormes, J. (Univ. of Minnesota, Minneapolis). p. 3-7 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The spectra of nuclei with z = 3 to 16, as well as protons and alpha particles, were measured in a balloon flight from Minneapolis on July 4, 1963. The integral intensities of the nuclei and the charge distribution were obtained, together with the altitude dependence of the counting rate for the medium and heavy nuclei. (D.C.W.)

34925 A STUDY OF THE MULTIPLY CHARGED NUCLEI OF THE PRIMARY COSMIC RADIATION NEAR THE GEOMAGNETIC EQUATOR USING NUCLEAR EMULSIONS. PART I. FRAGMENTATION PARAMETERS IN GRAPHITE. Badhwar, G. D.; Durgaprasad, N.; Vijayalakshmi, B. (Tata Inst. of Fundamental Research, Bombay). p.8-12 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

Four emulsion-graphite sandwich units were flown from Hyderabad, India, on March 24, 1960. Four different methods of charge identification were used to cover the range of charges (z = 2 to 28) of the primary and fragment nuclei. The interaction mean free paths of nuclei in the various charge groups were determined, together with fragmentation parameters for these groups. (D.C.W.)

34926 A STUDY OF THE MULTIPLY CHARGED NUCLEI OF THE PRIMARY COSMIC RADIATION NEAR THE GEOMAGNETIC EQUATOR USING NUCLEAR EMULSIONS. PART II. THE CHEMICAL COMPOSITION OF THE PRIMARY COSMIC RAY NUCLEI OF $Z \geq 6$. Badhwar, G. D.; Durgaprasad, N.; Vijayalakahmi, B. (Tata Inst. of Fundamental Research, Bombay). p.13-16 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The fluxes and intensity ratios of groups of nuclei with $z \geq 6$ were determined by an analysis of emulsion stacks flown by balloon over Hyderabad, India, on March 24, 1960. (D.C.W.)

34927 A STUDY OF THE MULTIPLY CHARGED NUCLEI OF THE PRIMARY COSMIC RADIATION NEAR THE GEOMAGNETIC EQUATOR USING NUCLEAR EMULSIONS. PART III. THE LIGHT NUCLEI OF THE COSMIC RADIATION. Durgaprasad, N. (Tata Inst. of Fundamental Research, Bombay). p.17-23 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The ratios of the intensities of B and Be nuclei to those of nuclei with $z \geq 6$ were measured in emulsion stacks flown by balloon over Hyderabad, India. The results were used to estimate the age of nuclei with $z \geq 6$ and the mean density of matter along the trajectories of these nuclei. (D.C.W.)

34928 FLUX AND ENERGY SPECTRA OF HEAVY PRIMARY NUCLEI MEASURED ON POLAR ORBITING SATELLITES. Yagoda, Herman (Air Force Cambridge Research Lab., Bedford, Mass.) Fukui, Katsura. p.24-31 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The time variation of the heavy primary flux between Dec. 7, 1960, and Aug. 29, 1963, was investigated using emulsion blocks exposed in polar-orbiting satellites. The differential energy spectrum was studied using emulsion disks exposed in a polar-orbiting satellite for 3.1 days, of which 1.05 days were spent at an average altitude of 284 ± 42 km in orbits at geomagnetics latitudes exceeding 55°. (D.C.W.)

34929 STUDY OF THE RELATIVE ABUNDANCE OF PRIMARY COSMIC RAY NUCLEI WITH $Z > 26$. Alvial, G.; Riquelme, J. (Universidad de Chile, Santiago). p.32-7 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The charge distribution of primary nuclei was obtained by scanning emulsion plates flown by balloon from Minneapolis, Minn. The fluxes of nuclei in various charge ranges at the top of the atmosphere were also determined. (D.C.W.)

34930 ENERGY SPECTRUM OF HEAVY NUCLEI OF PRIMARY COSMIC RAYS FROM SIMULTANEOUS FLIGHTS FROM TEXAS, U. S. A. AND HYDERABAD, INDIA. Badhwar, G. D.; Biswas, S.; Daniel, R. R.; Durgaprasad, N. (Tata Inst. of Fundamental Research, Bombay). p.38-40 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The energy spectrum of nuclei with $z \geq 6$ was investigated, using emulsion stacks flown simultaneously from Texas and from Hyderabad, India. The fluxes of these nuclei at the flight altitudes were obtained and extrapolated to the top of the atmosphere. It was concluded that the spectra of nuclei with $z \geq 6$ and of protons are the same, within the experimental errors. (D.C.W.)

34931 COSMIC RAY NUCLEUS COMPONENT INVESTIGATION, PERFORMED ON SOVIET SATELLITES AND PROBES. Ginsburg, V. L.; Kurnosova, L. V.; Logachev, V. I.; Razorenov, L. A.; Fradkin, M. I. (Lebedev Inst. of Physics, Moscow). p.41-5 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The relative abundances of nuclei with $z \geq 3$ were determined; and the fluxes of groups of nuclei with $z \geq 2$, $z \geq 5$, and $z \geq 12-14$ were measured as a function of latitude. The energy spectra of different groups of nuclei were obtained from the latitude dependences. A simultaneous increase of the total charged particle intensity and the flux of nuclei with $z \geq 5$ without any detectable flux increase for nuclei with $z \geq 15$ was observed on Aug. 20, 1960. (D.C.W.)

34932 CHANGES IN THE PRIMARY COSMIC RAY PROTON SPECTRUM IN 1962 AND 1963. Meyer, Peter (Univ. of Chicago); Vogt, Rochus. p.49-55 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The energy spectrum of primary protons in the energy range from about 80 to 350 Mev was investigated during the period 1960–1963, with particular consideration of the effects of solar activity. Changes between the years were observed. (D.C.W.)

34933 THE PRIMARY COSMIC RAY PROTON FLUX OVER HYDERABAD, INDIA (λ = 7.6°N). Bhatt, V. L. (Physical Research Lab., Ahmedabad, India) Daniel, R. R. p.56-9 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The flux of primary cosmic protons near the geomagnetic equator was determined from observations on freshly coated Ilford G5 emulsions flown by balloon over Hyderabad, India. (D.C.W.)

34934 THE ENERGY SPECTRUM OF PRIMARY COSMIC RAY PROTONS OF ENERGY 3-15 Gev FROM SIMULTANEOUS BALLOON FLIGHTS MADE FROM TEXAS (U. S. A.) AND HYDERABAD (INDIA). Daniel, R. R.; Sreenivasan, N. (Tata Inst. of Fundamental Research, Bombay). p.60-4 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The energy spectrum of primary cosmic protons in the energy range from 3 to 15 Bev was determined from observations on Ilford G5 emulsions flown by balloon from Brownwood, Texas, and Hyderabad, India. The proton fluxes at the flight altitudes were obtained and extrapolated to the top of the atmosphere. (D.C.W.)

34935 THE FLUX OF PRIMARY COSMIC RAY DEUTERONS AT A GEOMAGNETIC LATITUDE OF 7.6°N. Ganguli, S. N.; Rao, N. Kameswara; Swami, M. S. (Tata Inst. of Fundamental Research, Bombay). p.65-8 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The flux of primary deuterons was determined from observations on Ilford G5 emulsions exposed in a balloon flight from Hyderabad, India, on March 12, 1960. The flux was extrapolated to the top of the atmosphere. (D.C.W.)

34936 LOW ENERGY PROTONS, DEUTERIUM, AND ALPHA PARTICLES IN THE PRIMARY SPECTRUM IN 1963 AT FT. CHURCHILL AND MINNEAPOLIS. Webber, W. R.; Ormes, J. (Univ. of Minnesota, Minneapolis). p.69-75 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The intensities and spectra of primary alpha particles, deuterons, and protons were investigated, using scintillation counters flown by balloon from Ft. Churchill and Minneapolis during the summer of 1963. (D.C.W.)

34937 COSMIC-RAY INTENSITY AT THULE, GREENLAND AND ITS RELATION TO DATA FROM MARINER II. Neher, H. V.; Anderson, Hugh R. (California Inst. of Tech., Pasadena). p.76-80 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The cosmic-ray intensity was measured at high altitudes at Thule, Greenland, using ionization chambers flown on balloons. The intensity was extrapolated to the top of the atmosphere for 1962 and was compared with the intensity value obtained from Mariner II data. The extrapolated value was 21% higher than the value obtained from Mariner II data; the difference was attributed to the upward albedo at the pole. (D.C.W.)

34938 ON THE ISOTOPIC COMPOSITION OF HYDROGEN NUCLEI IN LOW ENERGY PRIMARY COSMIC RADIATION. Hasegawa, Hiroshi; Nakagawa, Shigeo; Tamai, Eiji (Rikkyo Univ., Tokyo). p.86-9 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The isotopic composition and energy spectrum of singly charged particles of low-energy cosmic radiation were investigated, using emulsion stacks flown by balloon from Sioux Falls, South Dakota, on Sept. 4, 1959. The fluxes of deuterons, protons, and tritons were obtained, together with the energy spectra of alpha particles, deuterons, and protons. The deuteron and proton fluxes were extrapolated to the top of the atmosphere. (D.C.W.)

34939 ISOTOPIC ABUNDANCE OF HELIUM NUCLEI IN PRIMARY COSMIC RADIATION. Aizu, Hideko (Rikkyo Univ., Tokyo). p.90-4 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The abundances of ^3He and ^4He in primary cosmic radiation were investigated, using emulsion stacks flown by balloon from Sioux Falls, South Dakota, on Sept. 4, 1959. (D.C.W.)

34940 THE ISOTOPIC COMPOSITION AND ENERGY SPECTRUM OF LOW-ENERGY HELIUM NUCLEI IN PRIMARY COSMIC RADIATION. Appa Rao, M. V. K; Dahnayake, C.; Kaplon, M. F.; Lavakare, P. J. (Univ. of Rochester, N. Y.). p.95-100 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The ratio $^3He/^3He + {}^4He$ in primary cosmic radiation was evaluated from observations on an emulsion stack exposed at Ft. Churchill on Aug. 4, 1962. The energy spectrum of ^4He nuclei was also obtained. (D.C.W.)

34941 THE HELIUM ISOTOPES IN THE PRIMARY COSMIC RADIATION. Hildebrand, B.; O'Dell, F. W.; Shapiro, M. M.; Silberberg, R.; Stiller, B. (Naval Research Lab., Washington, D. C.). p.101-9 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The relative abundances of ^3He and ^4He in primary cosmic radiation were evaluated on the basis of observations on Ilford K.2 emulsions flown by balloon at the magnetic latitude 55°N on April 21, 1961. (D.C.W.)

34942 ATTEMPT TO DETERMINE THE ISOTOPIC COMPOSITION OF HIGH-ENERGY HELIUM NUCLEI IN THE PRIMARY COSMIC RADIATION. Balasubramanyan, V. K.; Damle, S. V.; Gokhale, G. S.; Menon, M. G. K.; Roy, S. K. (Tata Inst. of Fundamental Research, Bombay). p.110-15 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The fluxes of helium nuclei in the primary cosmic radiation were measured, using a counter telescope system (Cherenkov and scintillation counters) flown by balloon from Hyderabad, India. The flux values were extrapolated to the top of the atmosphere, and the ratio $^3He/^3He + {}^4He$ at relativistic energies was evaluated. Notably, a gas Cherenkov counter was used in the telescope system. (D.C.W.)

34943 DETERMINATION OF CARBON ISOTOPES IN THE PRIMARY COSMIC RAYS. Alvial, G. (Universidad de Chile, Santiago). p.116-19 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

Two groups of nuclei with Z = 6 were observed in emulsion stacks exposed over Minneapolis, Minn. It was determined that the two groups consist of two carbon isotopes (unidentified). (D.C.W.)

34944 A MEASUREMENT OF LOW ENERGY COSMIC RAY PROTONS. Brunstein, K. A. (Univ. of California, Berkeley). p.120-2 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The primary proton spectrum at energies between 57 and 77 Mev was measured, using scintillation counters flown by balloon from Sioux Falls, South Dakota, and Churchill, Manitoba, in 1962. It was concluded that the particles observed in both cases were predominantly atmospheric secondaries. A statistical upper limit for the proton flux in terms of rigidity was obtained, which was considerably lower than that expected on the basis of a previous measurement at higher energies. (D.C.W.)

34945 ELECTRONS AND PHOTONS IN PRIMARY COSMIC RAYS. Hayakawa, Satio (Nagoya Univ., Japan).

p.125-52 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

A review of experimental and theoretical observations on primary cosmic electrons and photons is presented, covering intensities, spectra, sources, and production mechanisms. (D.C.W.)

34946 SOME PROBLEMS IN CONNECTION WITH THE GALACTIC ELECTRONS. Lund, N.; Swanenburg, B.; Tanaka, Y.; Wapstra, A. H. (Technical High School, Delft, Netherlands). p.163-6 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The energy spectrum of galactic electrons in the equilibrium state was calculated under the hypothesis that the electrons are decay products of mesons from nuclear collisions in interstellar space. The spectrum of synchrotron radiation from the galactic halo was then calculated from the electron spectrum. (D.C.W.)

34947 INVESTIGATION OF PRIMARY ELECTRONS AT 46° GEOMAGNETIC LATITUDE. Agrinier, B. (Centre d'Etudes Nucleaires, Saclay, France); Koechlin, Y.; Parlier, B.; Boella, G.; Antoni, G. Degli; Dilworth, C.; Scarsi, L.; Sironi, G. p.167-73 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The flux of electrons with a rigidity above the geomagnetic cut-off was determined from measurements with a spark chamber flown by balloon from Aire-sur-Adour, France. The proton flux was also estimated. The electron flux is about 1.5% of the proton flux. (D.C.W.)

34948 GAMMA AND X-RAY RADIATION CONNECTED WITH GALACTIC AND METAGALACTIC COSMIC RAYS. Ginzburg, V. L.; Syrovatsky, S. I. (Lebedev Inst. of Physics, Moscow). p.177-83 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

Some calculations of the gamma intensities from decay of mesons (π^0), bremsstrahlung radiation of relativistic electrons, and the inverse Compton effect are outlined. The results are discussed in relation to the observed intensity. (D.C.W.)

34949 INVESTIGATION OF PRIMARY GAMMA RAYS. Hafner, E. M.; Duthie, J. G.; Kaplon, M. F.; Share, G. (Univ. of Rochester, N. Y.). p.190-5 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The primary and secondary photon fluxes were previously measured using counter telescopes in which gamma rays were detected by counting electron pairs originating in lead. A discrepancy between the observed primary flux and that obtained from an experiment on Explorer XI was noted. Measurements with a modified detector system showed that the discrepancy was consistent with unsatisfactory rejection of background. Flux enhancement in the region of the galactic plane was also confirmed. (D.C.W.)

34950 100 CHANNELS, 0.1 TO 2 Mev γ-SPECTROSCOPY OF THE EARTH'S ATMOSPHERE BETWEEN 0 AND 160 KM. Boclet, D.; Ducros, G.; Labeyrie, J.; Rocchia, R. (Centre d'Etudes Nucleaires, Saclay, France). p.194-202 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The variation of the total gamma flux between 0.1 and 2.0 Mev was measured as a function of pressure through the atmosphere. The energy spectrum was also studied as a function of altitude. A strong line at 0.511 Mev was observed, the altitude dependence of which was obtained. Measurements were made in the atmosphere at a geomagnetic latitude of 41°N and above the atmosphere at 26°N. An NaI scintillator surrounded by a plastic scintillator was used. (D.C.W.)

34951 POSSIBLE LOCAL SOURCES OF GALACTIC X-RAYS. Hayakawa, S.; Matsuoka, M. (Nagoya Univ., Japan). p.213-16 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

Two possible sources of galactic x rays are proposed, connected with neutron stars and with early-type stars which form binary systems. (D.C.W.)

34952 THE PRODUCTION OF COSMIC RAYS IN VIOLENT EVENTS IN GALAXIES. Burbidge, Geoffrey (Univ. of California, San Diego, La Jolla). p.229-300 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

A review is given of the evidence for the occurrence of violent events in galaxies in which energies in the range 10^{55} to 10^{61} ergs are released. It is shown that such events are probably short lived (~10^6 years) as compared with the time scale of evolution of galaxies (~10^{10} years) and that they are then recurrent. Such outbursts give rise to the phenomena of strong radio sources and have many other effects. They are powerful sources of high-energy particles and their possible contribution to the primary cosmic-ray flux is discussed. The recent proposal by Hoyle and the author that the halo of this galaxy was produced by an explosion at the center some 10^7 years ago is described, and the bearing of this theory on the origin of cosmic rays is discussed. Finally, the possible energy sources which can give rise to violent outbursts are described. 100 references. (auth)

34953 THE ORIGIN OF COSMIC RAYS. Ginzburg, V. L.; Syrovatskii, S. I. p.301-32 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

A brief survey of theory for the origin of cosmic radiation is presented. Some calculations of electron and gamma intensities, electron spectra, and injection power are summarized. (D.C.W.)

34954 COSMIC-RAY ENERGY SPECTRUM AND HIGH-ENERGY PARTICLES IN SUPERNOVA. Sato, Humitaka (Kyoto Univ.). p.360-3 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The energy spectrum of cosmic radiation is analyzed in terms of particle production and acceleration at supernovae. The time variations of the electron and proton spectra at the source are considered, together with electron production. (D.C.W.)

34955 POSSIBLE ANISOTROPY OF COSMIC RAYS WITH RESPECT TO A SPIRAL ARM. Hayakawa, S.; Obayashi, H.; Sakakibara, S. (Nagoya Univ., Japan). p.364-9 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The anisotropy of extragalactic cosmic radiation was investigated theoretically, considering the effect of the magnetic structure of galactic spiral arms. The distributions of large extensive air showers were calculated and compared with experimental observations. The results indicate that cosmic rays with rigidities as high as 2×10^{18} v are of extragalactic origin. (D.C.W.)

34956 ON THE CONFIGURATION OF RELATIVISTIC PARTICLES GENERATED BY A SUPERNOVA IN THE GALACTIC ARM AND AN INTERPRETATION OF THE RADIO SPUR. Oda, M. (Massachusetts Inst. of Tech., Cambridge); Hasegawa, H. p.370-6 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The North Polar Spur is explained in terms of synchrotron radiation from a certain configuration of relativistic electrons ejected by a supernova into a magnetic arm of the galaxy. (D.C.W.)

34957 TRANSFORMATIONS IN THE COMPOSITION OF THE GALACTIC COSMIC RADIATION DURING ITS TRAVERSAL IN SPACE. Badhwar, G. D.; Daniel, R. R.; Vijayalakshmi, B. (Tata Inst. of Fundamental Research, Bombay). p.390-2 of "International Conference on Cos-

mic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The effects of the decay of radioisotopes produced in collisions of cosmic-ray nuclei with hydrogen in space on the composition of the heavy nuclei in the region of the earth was investigated. The production cross sections for the individual isotopes resulting from such collisions at energies ≥300 Mev/n were derived, and the energy dependence of the production cross sections for ^{3}He, Li, B, and Be nuclei were investigated. The amount of hydrogen traversed by the radiation between the source region and the vicinity of the earth was calculated. (D.C.W.)

34958 PRIMARY COSMIC RADIATION OF ULTRA-HIGH ENERGY. Khristiansen, G. B.; Abrosimov, A. T.; Atrashkevich, V. B.; Kulikov, G. V.; Solovyova, B. I.; Fomin, Yu. A.; Kchrenov, B. A. p.393-8 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

The composition and energy spectrum of galactic and metagalactic cosmic radiation were investigated on the basis of experimental observations of the meson (μ) flux in extensive air showers, using the diffusion model of cosmic-ray propagation. (D.C.W.)

34959 SECONDARY GALACTIC ELECTRONS. Jones, Frank C. (Goddard Space Flight Center, Greenbelt, Md.). p.399-403 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

A calculation of the energy spectrum of secondary galactic electrons is discussed in which a simplified version of the isobaric nucleon model of Lindenbaum and Sternheimer was incorporated in the model of high-energy collisions. The theoretical spectrum of mesons (π) from collisions between cosmic protons and interstellar hydrogen nuclei is included, together with the energy spectrum of electrons from the decay of these mesons (π). (D.C.W.)

34960 GENERAL DISCUSSION ON ORIGIN OF COSMIC RADIATION. p.407-17 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

Some difficulties in the theory of the origin of cosmic radiation are briefly discussed, together with some experiments that would provide useful information on cosmic radiation. The distribution of high-energy nuclei in the universe, the age of cosmic rays, the existence of antiparticles in cosmic radiation, the effects of distinct sources in cosmic radiation, the history of cosmic radiation as recorded in meteorites, and the possibility of galactic origin of very high energy cosmic rays are considered. (D.C.W.)

34961 ON THE ROTATION OF COSMIC RAY ANISOTROPY. Altukhov, A. M.; Kuzmin, A. I.; Krimsky, G. F.; Skripin, G. V.; Chirkov, N. P. (Inst. of Cosmophysical Research and Aeronomy, Academy of Sciences, Siberian SSR). p.421-7 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

Some observations of the rotation of cosmic-ray anisotropy are summarized, together with the results of a spherical analysis of data for several days in Dec. 1957 on which such rotation was observed. An explanation for the origin and rotation of the anisotropy is then proposed. (D.C.W.)

34962 EXPERIMENTAL EVIDENCE ON THE HISTORY OF COSMIC RADIATION. Geiss, J. (Universitat, Bern). p.434-65 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

A survey of experimental observations on the history of cosmic radiation is presented, with emphasis on the methods used to detect intensity variations during different periods of time. Experimental results are considered, as well as the theory used to interpret the data. 58 references. (D.C.W.)

34963 COSMIC RAY DATA DERIVED FROM ISOTOPE STUDIES IN METEORITES. Waenke, H. (Max-Planck-Institut fur Chemie, Mainz). p.473-9 of "International Conference on Cosmic Rays. Vol. 3." Bombay, Tata Inst. of Fundamental Research, 1964.

Some investigations are summarized in which cosmic radiation was studied by determining Ar, Cl, and K isotopes in meteorites and in which the solar wind was investigated by determining He and Ne in meteorites. (D.C.W.)

34964 INTERNATIONAL CONFERENCE ON COSMIC RAYS, JAIPER, DECEMBER 2-14, 1963, PROCEEDINGS. VOLUME 6. MUONS AND NEUTRINOS. Under the Auspices of The International Union of Pure and Applied Physics and The Department of Atomic Energy, Government of India. Daniel, R. R.; Lavakare, P. J.; Menon, M.G.K.; Naranan, S.; Nerurkar, N. W.; Pal, Yash; Sreekantan, B. V., eds. Bombay, The Commercial Printing Press Limited, 1964. 261p. Available from Tata Inst. of Fundamental Research, Bombay. (CONF-320)

Separate abstracts are prepared for 29 of the 32 papers presented. Three papers previously appeared in NSA (18: 28285, 32498, and 32499). (C.E.S.)

For abstracts of individual papers see: 34965, 34966, 34967, 34968, 34969, 34970, 34971, 34972, 34973, 34974, 34975, 34976, 34977, 34978, 34979, 34980, 34981, 34982, 34983, 34984, 34985, 34986, 34987, 34988, 34989, 34990, 35179, 35180, and 35509.

34965 HIGH ENERGY MUONS. Wolfendale, A. W. (Univ. of Durham, Eng.). p.3-21 of International Conference on Cosmic Rays. Vol. 6, Bombay, Tata Institute of Fundamental Research, 1964.

A discussion of the energy spectrum of mesons(μ) in the vertical direction (at, or near sea level) is presented. Corrections to the sea level meson(μ) spectrum were attempted, but the results are inconclusive. At high energies the rate of energy loss is given to good accuracy. The proton spectrum at sea level and the meson(μ) spectrum show the energy lost by nucleons to parents of mesons(μ). The meson(π) spectrum is derived from the meson(μ) spectrum assuming that sea level mesons(μ) all originate from mesons(π). (J.F.P.)

34966 INTENSITY MEASUREMENTS OF COSMIC RAYS DEEP UNDERGROUND AND THE ENERGY SPECTRUM OF MUONS AT SEA LEVEL. Ramana Murthy, P. V. (Tata Inst. of Fundamental Research, Bombay). p.22-35 of International Conference on Cosmic Rays. Vol. 6, Bombay, Tata Institute of Fundamental Research, 1964.

Measurements of cosmic ray intensities deep underground are made to fill a gap in cosmic ray phenomena and to extend the cosmic ray energy spectrum to a region inaccessible to direct measurement. Such deep underground measurements give the intensities at various depths and agree within statistical error. The energy spectrum at sea level is deduced from the observed intensities. The slope of the energy spectrum of muons expressed as a power law increases with energy. Measurement of γ ray cascades show that the k/π ratio is quite small. Analysis of this evidence shows an upper limit to nuclear collision losses. (J.F.P.)

34967 INDIRECT DETERMINATION OF THE K/pi RATIO FROM COSMIC RAY MEASUREMENTS. Osborne, J. L.; Wolfendale, A. W. (Univ. of Durham, Eng.). p.36-40 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The meson(k)/meson(π) ratio is found from a number of meson(μ) studies. Meson(μ) polarization studies give a ratio of 40 ± 20%. Momentum spectra of inclined mesons(μ) give a ratio of less than 0.1 over a much higher energy range. The flux of γ quanta and electrons also give results which help to determine this ratio. The resulting curve of K/π versus mean primary energy rises with energy, then levels off and falls; at higher energies. There is evidence of a further rise, but the statistical errors are large in this region. (J.F.P.)

34968 THE CHARGE RATIO OF COSMIC RAY MUONS AT SEA LEVEL. MacKeown, P. K.; Pattison, J. B. M.; Ramana Murthy, P. V.; Wolfendale, A. W. (Univ. of Durham, Eng.). p.41-4 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The horizontal spectrograph was used to measure the charge ratio of muons incident between 77.5 and 90° to the zenith. The results were taken from a sample of 4453 particles recorded in a total running time of 625 hours. The important systematic errors were eliminated by daily reversals of the magnetic field. The results for particles of momenta below 100 Bev/c are tabulated. (J.F.P.)

34969 DERIVATION OF THE MUON CHARGE RATIO USING A SIMPLE PION PRODUCTION MODEL. Frishman, Y.; Yeivin, Y. (Hebrew Univ., Jerusalem). p.45-50 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The observed vertical meson $(\mu^+)/(\mu^-)$ ratio at sea level was previously explained by several collision models, but these models were unsuccessful in some respects. Another modification of the simple mesons(π) only model is considered. The values so obtained agree very well with observed charge ratio values. The experimental and calculated charge ratios are tabulated and compared. (J.F.P.)

34970 MULTIPLE-PIONS PRODUCTION BY HIGH ENERGY MUONS. Higashi, S. (Osaka City Univ.), Kitamura, T.; Mishima, Y.; Miyamoto, S.; Shibata, H.; Watase, Y. p.53-9 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

Studies of low energy mesons(μ) show that static characters of the meson(μ) are identical with the electron in all but mass. But high energy studies may show the distinction between the meson(μ) and the electron. The observations of meson(μ) showers were compared with such showers estimated from the Heitler, Kessler-Kessler, theories, and the DKMN theory. Two cloud chambers in which the one containing lead plates is above the other containing iron plates were used to investigate 133 events of the penetrating showers produced by mesons(μ) having energies of 10 Bev to a few hundreds of Bev. The results of the observations suggested that at least 10% of the multiple meson(π) productions by mesons(μ) at 0.1 fermi have core-like interactions. (J.F.P.)

34971 THE MUON MOMENTUM SPECTRUM AT VARIOUS ZENITH ANGLES. Judge, R. J. R.; Nash, W. F. (Univ. of Nottingham, Eng.). p.60-3 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

To obtain information concerning the spectrum of the parents of mesons(μ) and concerning mesons(π) and mesons(k) of higher energies, measurements were made of the momentum spectra of mesons(μ) arriving at 30, 45, and 60° in the east-west azimuth at a latitude of 53° north. The sea level momentum spectra show expected hardening with increasing θ. Charge ratio investigations agree with previous measurements, with results confirming the decline of the ratio with momentum. The power of the cosine of the zenith angle as a function of intensity is shown to decrease with increasing momentum. Another result shows that mesons(μ) are derived from mesons(π) at zenith angles less than or equal to 60°. (J.F.P.)

34972 MOMENTUM MEASUREMENTS OF MU-MESONS USING A SOLID IRON MAGNET. Rastin, B. C.; Nash, W. F.; Bull, R. M. (Univ. of Nottingham, Eng.). p.64-7 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

Momenta of mesons(μ) are measured by angular deflections produced by a known magnetic field. A spectrograph consisting of solid iron magnets and neon flash tubes was investigated to determine its usefulness for this type of work. The agreement between theoretical and observed distributions was good. Differential meson(μ) spectra were measured. The results were found to be in good agreement with previous measurements and confirmed the meson(π) parentage for the mesons(μ). (J.F.P.)

34973 THE SPECTRUM OF MUONS ARRIVING AT LARGE ZENITH ANGLES. Judge, R. J. R.; Nash, W. F. (Univ. of Nottingham, Eng.). p.68-71 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The meson(K) contribution to the sea level meson(μ) flux at large zenith angles is estimated. The observation of 716 trajectories of single particles shows that the meson(K) contribution to the meson(μ) flux at zenith angles between 83 and 90° has a maximum value of 30% in the meson(μ) production momentum range 40 to 90 Bev/c. The meson(μ) flux at large zenith angles was found to be relatively rich in low energy particles. This is due to Coulomb scattering in the atmosphere. (J.F.P.)

34974 THE MOMENTUM SPECTRA OF COSMIC RAY MUONS AT LARGE ZENITH ANGLES. Ashton, F.; MacKeown, P. K.; Pattison, J. B. M.; Ramana Murthy, P. V.; Wolfendale, A. W. (Univ. of Durham, Eng.). p.72-5 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

A spectrograph that accepts particles incident from the direction N9°E over the range of zenith angles 77.5 to 90° was used to determine the momentum spectra of cosmic mesons(μ). Particles are selected by a four-fold coincidence of Geiger counters and an anticoincidence from a shower tray. The maximum detectable momentum of the instrument is 179 Bev/c. The K/π ratio was also determined. (J.F.P.)

34975 INVESTIGATION OF COSMIC RAY MUONS POLARIZATION AT VARIOUS ENERGIES AND ESTIMATION OF $(K^+/K^+ + \pi^+)$ RATIO. Asatiani, T. L.; Sharkhatunyan, R. O. p.76-9 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

Since the polarization of mesons(μ) depends partly on the meson(π) energy spectrum and partly on the contribution of mesons(K) as parent particles of the mesons(μ), evidence of the mesons(K) contribution to meson(μ) generation can be found by measuring the absolute value of the polarization and by investigating its dependence on the initial energy of the mesons(μ). Polarization measurements were obtained by three different methods and show that the contribution of meson(K) decay is essential. The ratio $(K^+/K^+ + \pi^+)$ was calculated assuming cosmic mesons(μ) originate only from $K_{\mu 2}$ and π decay and was found to be 0.23 ± 0.05. (J.F.P.)

34976 MULTIPLE PENETRATING PARTICLES UNDERGROUND (148 m.w.e.). Chaudhuri, N.; Sinha, M. S. (Regional Engineering Coll., Durgapur, India). p.106-10 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The simultaneous occurrence of two or more penetrating particles were recorded by special type of detectors and were regarded as beams of mesons(μ). A multiplate cloud chamber was used to detect such events at depths of 148 mwe. The individual particles in these events penetrated all cloud chamber plates besides 20 cm of lead and were found parallel within 2° inside the cloud chamber. A comparison of data shows that the frequency of these events does not depend on the underground depth of observation. (J.F.P.)

34977 FLUCTUATION OF NUMBER OF PARTICLES IN AN ELECTRON-PHOTON SHOWER AND THEIR INFLUENCE ON THE SPECTRUM OF BURSTS PRODUCED BY HIGH ENERGY μ-MESONS UNDER THICK FILTERS. Gerasimova, N. M. p.111-16 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

A physically direct derivation of the equation for the function $\phi(E,t,N)$ is presented. This function is the probability that in traversing the depth t, a particle of energy

E_0 produces N particles. In considering showers initiated by an electron or a photon of energy 10^{12} ev in iron, the nature of the curve does not change essentially with energy. In considering the influence of the fluctuations in the electron-photon shower on the spectrum of bursts produced by high energy mesons(μ) under thick filters, it is found that the number of bursts increases somewhat. (J.F.P.)

34978 THE MOMENTUM DEPENDENCE OF THE MOST PROBABLE ENERGY LOSS OF COSMIC RAY MUONS IN A LIQUID SCINTILLATOR. Ashton, F.; Simpson, D. A. (Univ. of Durham, Eng.). p.117-20 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

Ionization loss of fast mesons(μ) is studied using a scintillation counter. The results confirm the existence of the density effect to the highest momenta measured and are not inconsistent with a small decrease in ionization loss at high momenta. (J.F.P.)

34979 THE RATE OF ENERGY LOSS OF COSMIC RAY MUONS IN A PLASTIC SCINTILLATOR. Crispin, A. (Northern Polytechnic, London); Hayman, P. J. p.121-3 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The momentum of the incident meson(μ) and the energy lost by the meson(μ) in traversing an absorber is measured by using the Durham Cosmic Ray Spectrograph in whose beam a scintillation counter is placed, from which pulses were recorded photographically. The experimental valves of the most probable energy loss agree with theoretical predictions up to 10 Bev/c. For greater momenta the present results indicate a slight increase over the theoretically predicted rise for a plastic scintillator. There is no indication of a decrease in energy loss soon after the plateau value has been reached. (J.F.P.)

34980 THE SEA LEVEL ENERGY SPECTRUM OF COSMIC RAY MUONS AT ENERGIES ABOVE 10^{11} ev. Krasilnikov, D. D. p.124-8 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

An analysis of large ionization bursts in shielded spherical chambers used 10^5 cascade particles. The burst data were converted into the integral energy spectrum data. The conversion was made by an approximate integration of an equation for bursts produced by mesons(μ) in the processes of bremsstrahlung, knock-on, pair production, pair creation, and nuclear interaction. The results showed that mesons(μ) of energies 10^{11} to 10^{12} ev are generated through meson(π)–meson(μ) decay, though at higher energies other processes may also be generators. Energy loss of mesons(μ) in the ground due to pair production, bremsstrahlung, and nuclear interaction is greater than 3×10^{-6} Mev g^{-1} cm^2. (J.F.P.)

34981 COSMIC NEUTRINO SOURCES. Chiu, Hong-yee (Academia Sinica, Peking). p.131-51 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

Properties of the neutrino are discussed including those relevant to production and detection. The existence of the intermediate boson is assumed for weak interactions. The production of neutrinos in astrophysical processes is considered. Among the various neutrino processes are the photo-neutrino process, the annihilation process, and the plasma process in which a photon inside an electron gas can decay into two neutrinos. Neutrinos may be detected by the counter method and by the radiochemical method. (J.F.P.)

34982 NEUTRINO EXPERIMENTS DEEP UNDERGROUND. Menon, M. G. K. (Tata Inst. of Fundamental Research, Bombay). p.152-81 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

Underground investigations offer possible observations of sad atmospheric neutrinos and neutrinos of extra-terrestrial origin. Both elastic and inelastic properties have been observed. Conclusions from underground experiments show that elastic scattering of meson(μ) neutrinos off nucleons may exist and that there is an upper limit for the energy density of neutrinos and antineutrinos and a lower limit for the lifetime of the proton. At depths around 8400 mwe charged particle intensities from neutrino interactions are comparable to atmospheric meson(μ) intensities to about a factor of ten. The counting rate can be explained by choosing various parameters. Weak interactions, the intermediate boson, and the Glashow resonance are uncertain from these results. While there are good reasons for expecting a flux of extra-terrestrial neutrinos at the top of the atmosphere, this too has not yet been observed. (J.F.P.)

34983 A SEARCH FOR INTERACTIONS PRODUCED BY COSMIC RAY NEUTRINOS. Reines, F. (Case Inst. of Tech., Cleveland); Jenkins, T. L.; Crouch, M. F.; Sellschop, J. P. F. p.182-9 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

Preparations made for a large-scale underground experiment to detect neutrino-induced interactions are described. The proposed liquid scintillator array will comprise 84 detectors aggregating 300 m^2. The expected signal will be 10 counts per year with a relatively small background of cosmic mesons(μ). If there is an intermediate boson the rate may be higher. Cherenkov detectors are also considered, but these must be operated at a great depth. (J.F.P.)

34984 ISOTOPIC CHANGES INDUCED BY NEUTRINOS. Lal, D. (Tata Inst. of Fundamental Research, Bombay). p.190-208 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The possibility of carrying out neutrino spectroscopy by studying isotopic changes induced by the capture of neutrinos in terrestrial materials is discussed. However, the methods of detection are very difficult and expensive. They would involve the detection of solar and stellar neutrinos. The capture of neutrinos with ^9Be and the Pontecorvo-Davis reaction are considered. The production of isotopes by environmental radiation deep underground is another possibility considered. (J.F.P.)

34985 FLUX OF ATMOSPHERIC NEUTRINOS OF DIFFERENT TYPES AT SEA LEVEL AND COSMIC RAY NEUTRINO EXPERIMENTS. Cowsik, R.; Pal, Yash; Rengarajan, T. N.; Tandon, S. N. (Tata Inst. of Fundamental Research, Bombay). p.211-16 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The spectra of ν_e, $\bar{\nu}_e$, ν_μ, and $\bar{\nu}_\mu$ incident in the vertical and horizontal directions at sea level were separately obtained by considering contributions from mesons(π), mesons (μ), and mesons(K). The total flux of all neutrinos at a few Bev agrees very well with that of other experimenters. It is found that in the vertical direction meson(K) decay dominates the neutrino flux, in the horizontal direction mesons(μ) are the chief contributors, that the ratios of horizontal to vertical fluxes are always greater than unity, and that the ratio $\nu_\mu/\bar{\nu}_\mu$ is large. If in nuclear collisions the meson(K^+)/meson (K^-) ratio is high at the upper end of their energy spectrum, then the neutrino-induced mesons(μ) will show a large negative excess. (J.F.P.)

34986 THE ANGULAR DISTRIBUTION AND THE ENERGY LOSS OF THE FAST MUONS. Petrukhin, A. A.; Kotov, Yu. D.; Rosental, I. L. p.219-25 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

In calculating the integral energy spectrum at sea level it is found necessary to make corrections for angular distributions and energy losses. Such corrections and approximations for bremsstrahlung, for pair production, and for the influence of atomic electrons are discussed. (J.F.P.)

34987 CALCULATION OF THE RANGE FLUCTUATION OF HIGH ENERGY μ MESONS. Nishimura, Jun (Tokyo

Univ.). p.224-8 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The meson(μ) spectrum is compared with that of γ rays up to 10^{13} ev. The problem is treated analytically by assuming constant ionization loss, and complete screening cross sections for bremsstrahlung and for pair production. It is shown that the energy spectrum of high energy mesons (μ) compared with energy higher than 10^{12} ev is well represented by a power law with an exponent 3.2 ± 0.2. (J.F.P.)

34988 THE COMPARISON OF THE MUON ENERGY SPECTRUM AT SEA-LEVEL WITH THE UNDERGROUND RANGE SPECTRUM. Kitamura, T.; Takahashi, T. (Osaka City Univ.). p.229-34 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

Previously deduced sea-level spectra are compared with observed underground range spectra taking into account the energy loss due to ionization and excitation, direct pair production, bremsstrahlung, and meson(π) production. (J.F.P.)

34989 MUONS AND NEUTRINOS. Rochester, G. D. (Univ. of Durham, Eng.). p.237-42 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

An attempt is made to briefly review and summarize the conference material presented on meson(μ) and neutrino spectra and the detection of neutrinos. (J.F.P.)

34990 FLUCTUATIONS OF THE SOFT COMPONENT GENERATED BY MU-MESONS UNDER BIG THICKNESS OF THE ABSORBER. Gedalin, E. V. (Inst. of Physics, Academy of Sciences, Georgian SSR). p.245-8 International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The possibility of registration and determination of the energy of a single meson(μ) with the energy $E \gtrsim 10^{12}$ ev by means of a many layer system of ionization chambers selecting small bursts is considered. An attempt is made to derive the probability equation $P(n,E,t)$ that a meson(μ) of energy E creates an avalanche of n electrons at the depth t in this avalanche. (C.E.S.)

Direct Energy Conversion

Refer also to abstract 34636.

34991 (AD-425930) INVESTIGATION OF THE CURRENT DENSITY LIMITATIONS IN A THERMIONIC CONVERTER. Technical Summary Report, March 1, 1963–October 31, 1963. Kaplan, Coleman (Astro, Van Nuys, Calif.). Contract NONR 3738(00). 40p. $1.25(CFSTI).

A pulsed-discharge measurement technique was used to obtain current-voltage characteristics for a cesium thermionic converter. This experimental technique consists of steady-state or pulsed operation at a high-current level, followed by rapid switching to a lower output current, where the measurement is made. Ions formed during the high-current operation provide space-charge neutralization at the lower output current, so that space-charge limitation of the output is not present during the measurement. Comparison of the pulsed-discharge data with the steady-state current-voltage characteristic and with the Boltzmann line allows measurement of the electron transport losses (due to space-charge and plasma resistance) normally present during steady-state operation. In addition, the collector work function can be measured under realistic diode operating conditions—i.e., large output current density and high collector temperature. Information pertaining to the variation of the emitter work function is also obtained. Work functions ranging from 1.80 to 1.95 ev were measured for the stainless-steel collector. These values are higher than expected for the operating conditions used. Several possible reasons for the discrepancy are discussed. (auth)

34992 (AD-612471) BASIC PHENOMENA IN THERMIONIC ENERGY CONVERTERS. Final Report, February 1, 1961–November 1, 1963. Oskam, Hendrick J. (Minnesota Univ., Minneapolis. Plasma Physics Research Lab.). June 1964. Contract AF19(604)-8072. 42p. (AFCRL-64-560; N64-31402) $2.00(CFSTI).

A summary is presented of a study of phenomena related to the physics of thermionic energy converters as well as the investigation of the processes responsible for the high efficiency of the hollow-cathode discharge. Machine computations of the transport of charged particles under the influence of both electric fields and density gradients, while allowing for a changing particle energy, revealed the possibility of ionization of neutral particles by electrons having traversed a voltage difference smaller than the ionization potential of the neutral particles involved. The theoretical results obtained are compared with experimental data. A systematic study of the current-voltage characteristics of a plane and hollow-cathode discharge led to a considerably better insight in the significance and magnitude of the hollow-cathode discharge mechanism. (auth)

34993 (AD-612602) 300-WATT PORTABLE THERMOELECTRIC GENERATOR. Monthly Progress Report No. 5 for Period Ending February 28, 1965. Carlton, R. D. (Minnesota Mining and Mfg. Co., St. Paul). Contract N600-61533-62758. 5p. $1.00(CFSTI).

Detail and assembly drawings for the generator were completed. A modification of the burner resulted in a heat flux of 41 watts/sq in. at an efficiency of 65.5%. Test fixtures for the thermoelectric couples are being fabricated. (CFSTI)

34994 (AD-612710) RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION. Quarterly Technical Progress Report No. 6, December 1, 1964–February 28, 1965. Jackson, William D.; Brown, George A.; Kerrebrock, Jack L.; Stickney, Robert E. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Mar. 15, 1965. Contract AF33(615)-1083. 34p. $2.00 (CFSTI).

Research is reported on an MHD induction machine with laminar fluid flow, the behavior of dry potassium vapor in electric and magnetic fields, and the bonding of alkali-metal atoms adsorbed on metal surfaces. (D.C.W.)

34995 (AD-612901) RESEARCH PROGRAMME ON MAGNETOPLASMADYNAMIC POWER GENERATION. Final Technical Summary Report, April 1–July 31, 1964. Lindley, B. C. (International Research and Development Co. Ltd., Newcastle-upon-Tyne (England)). Contracts N62558-3127 and N62558-4180. 185p. (IRD-64-59) $5.00 (CFSTI).

A summary of research on MHD generation is presented covering loop operation, power generation experiments, cesium injection and recovery, generator ducts, instrumentation, microwave studies on nonequilibrium plasma, atomic beam experiments, microwave studies of thermally excited plasmas, and heat transfer and pressure loss calculations for He–He recuperative heat exchangers. (D.C.W.)

34996 (CONF-650316-1) EFFECTS OF INERT GAS OVERPRESSURE ON ARC CHARACTERISTICS. Bullis, R. H.; Wiegand, W. J.; Bell, D. W. (United Aircraft Corp., East Hartford, Conn. Research Labs.). [1964]. Contract AF49(638)-1221. p.9.

From 25th Annual Conference on Physical Electronics, Cambridge, Mass.

To determine the effect of the presence of an inert gas on the properties of the nonequilibrium cesium plasma in the interelectrode space of an arc-mode thermionic converter, detailed electrostatic probe measurements were made of electron temperature, electron number density, and plasma potential over a wide range of inert gas pressures. By employing electrostatic probe techniques, direct assessment was made of the effects of an overpressure of inert gas without introducing extraneous effects such as

changes in the work functions of the emitter and collector. Spectroscopic measurements were made to determine the behavior of the atomic and molecular excited state populations with changes in inert gas pressure, converter output, and maximum electron density in the neutralization plasma. The range of argon pressure over which volume ionization processes can be sustained in the non-equilibrium neutralization plasma was determined from these measurements. Correlation of results from the electrostatic-probe and spectroscopic measurements indicates that multistage ionization processes are not the dominant mechanism responsible for the ionization enhancement observed in the arc-mode operation. (auth)

34997 (IPP-4/18) ELEKTRONISCHE ROHREN ALS THERMIONISCHE KONVERTER. (Electronic Tubes as Thermionic Converters). Mantel, J. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Dec. 1964. 11p. Dep.(mn).

Observations of the thermionic emission in vacuum tubes showed very low direct conversion efficiency of the thermic energy into electricity. The problem of improving the conversion efficiency by means of accelerating grids was investigated in triodes. The results are presented and explained. (auth)

34998 (N64-26578) DESIGN STUDY OF A SOLAR HYDROGEN PROPULSION AND POWER SYSTEM. Final Report, May 17 – November 16, 1963. McFarlane, F.; Kalensher, B.; Wilner, B.; Findl, E. (Electro-Optical Systems, Inc., Pasadena, Calif.). July 23, 1964. Contract NAS 7-231. 134p. (NASA-CR-56977; EOS-4000-Final) $10.50(CFSTI)

A study was made of the conversion of solar energy into heat and the utilization of this heat for electric power generation and propulsion by means of a hybrid engine. Problems arising because of thermodynamic, vehicle-integration, geometric, and space-environment considerations are discussed. The performance analysis of the solar hydrogen rocket—solar energy thermionic system, the design analysis of the combined cavity-absorber, a preliminary design for a 24-hr satellite system, and mission studies to define performance characteristics for comparative propulsion systems (electric and chemical) for a solar probe mission and earth orbit transfer cases are reported. (M.J.T.)

34999 (NASA-TN-D-2873) SEEDING CRITERION FOR NONEQUILIBRIUM MAGNETOHYDRODYNAMIC GENERATORS. Lyman, Frederic A.; Reshotko, Eli (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). June 1965. 60p. $3.00(CFSTI).

The various consequences of the addition of seed to a carrier gas in a magnetohydrodynamic (MHD) generator are examined. In particular, a criterion is established for determining whether the net effect of seed addition is to augment or decrease the power density in MHD generator channels that use magnetically induced nonequilibrium ionization. The analysis considers the effects of electron-neutral collisions, electron-ion collisions, ion slip, and variation of the electron energy loss factor with seed fraction and seed material. Included in the consideration of ion slip are the effects of seed fraction and seed material on ion-neutral collision frequency and on the relative drifts between seed ions and carrier ions. The presented criterion is based on the determination of a break-even condition; namely, that combination of gas density, magnetic field, and induced voltage for which the power density of the unseeded carrier is neither augmented nor decreased by the addition of seed. The formulation is given in general terms and is applicable for arbitrary combinations of monatomic carrier and seed materials. The criterion may be separately applied to each successive station of a segmented-electrode Faraday generator. Calculations of the break-even condition for various noble carrier gases with alkali seed were performed and are presented in graphical form. The results indicate that ion slip very strongly affects the break-even conditions. Generally speaking, seeding is desirable, and the most beneficial effects are obtained for heavy seed materials. (auth)

35000 (NP-15086) SUMMARY REPORT ON SELECTED TOPICS RE-ENTRY PHYSICS (REP) PROGRAM. VOLUME II. UNCLASSIFIED PORTION. (Avco-Everett Research Lab., Everett, Mass.). Apr. 1965. Contract AF04(694)-414. 100p.

Methods for controlling and using the energy dissipated in air by a re-entry vehicle were explored; the interaction of the air with a magnetic field (MHD interaction) to generate an emf was considered. The concept of a vehicle which generates electric energy is discussed. Studies directed toward MHD power generation are described, including Hall and nonequilibrium effects, conductivity of plasmas, nonuniformity effects, actual power generation, and the application of MHD generators to space power and propulsion systems. Work directed toward making the use of superconducting magnets practical is reported. The use of MHD to extend the performance of the shock tube as an experimental tool is described. The problem of radiation shielding in space travel is dealt with, and the possibility of exerting forces on the gas and on the vehicle in flight for purposes of control and heating reduction is considered. (M.J.T.)

35001 (NP-15088) DETAILED PERFORMANCE EVALUATION OF THE MARK V SELF-EXCITED ROCKET-DRIVEN MHD GENERATOR. Final Technical Report. (Avco-Everett Research Lab., Everett, Mass.). May 1965. Contract AF33(615)-1862. 91p.

The basic design of a rocket-driven MHD generator, operating by adding ionizable impurity to the rocket combustion chamber to render the exhaust electrically conducting, is described. The operating-time, weight, and economic characteristics of such a generator as a function of power output are considered. Accomplishments made and problems encountered during the test program of the Mark V generator are summarized. A description of the Mark V, burning gaseous oxygen and seeded alcohol, is given, including developments on the burner, the magnet, the channel and exhaust system, and the generator control and instrumentation. The testing program, directed to developing the self-excitation techniques and to producing 20 Mw net power output, is discussed; relations between battery pre-excitation, burner ignition time, and rate of excitation and the establishment of the proper voltage distribution in the segmented electrode power section are considered. (M.J.T.)

35002 (TID-7687(Suppl.)) THERMOPHYSICAL AND TRANSPORT PROPERTIES OF HIGH TEMPERATURE ENERGY STORAGE MATERIALS. Sharma, R. A.; Chang, H. (Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion). [1963]. Contract AT(30-1)-2202. 12p. (CONF-458-3). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From 3rd Annual Symposium on High Temperature Conversion Heat to Electricity, Tucson, Ariz., Feb. 1964.

A preliminary literature survey showed some metals, compounds, and eutectic mixtures to be likely suitable thermal energy storage materials. The melting points and heats of fusion or eutectic temperatures and estimated heats of fusion of these materials—mainly silicides, oxides, and fluorides of light metals—are tabulated. Techniques and experimental apparatus for measuring their thermophysical and transport properties are described, including a differential thermal analysis apparatus, consisting of a Pt–Rh furnace and a calorimeter. Further areas of research in the development of these materials are pointed out. 30 references. (M.J.T.)

35003 ON THE WORKING BEHAVIOR OF TRAVELING-WAVE MHD GENERATORS WITH REGARD TO BOUNDARY LAYER. Weh, H.; Grumbkow, P. V. (Technische Hochschule, Brunswich). Advan. Energy Conversion, 5: 57-69 (May 1965). (In German)

Due to friction, the fluid near the channel wall of electrodeless MHD generators moves more slowly than in the middle of the channel. Thus, additional losses are caused in the fluid. Under simplified conditions (as trapezium-

shaped fluid velocity, no current displacement and partly neglected leakage coefficient), these losses were ascertained. Especially with small channel heights having a relatively thick boundary layer and with small slips, losses can amount to much more than those calculated for constant velocity in the whole channel. In order to get a realistic performance calculation, the thickness of the layer has to be well estimated. The thickness results out of the balance between the frictional resistance and the electromagnetic force. (auth)

35004 THE BASIC EQUATIONS OF TRAVELING-WAVE MHD GENERATORS WITH CONSIDERATION OF IRON SATURATION. Weh, H. (Technische Hochschule, Brunswick). Advan. Energy Conversion, 5: 83-91(May 1965). (In German)

It is shown that it is possible to take the magnetic potential difference within the iron into account by generalized boundary conditions. Thus, the calculation does not require the addition of a further field section for the iron; the number of integration constants is not increased. The iron saturation needs to be taken into account because, for the operation of a self-excited MHD generator, it is necessary to have a curved voltage-current characteristic. Furthermore, greater channel heights require establishing certain ranges of saturation within the iron, in order to get the desired curved voltage-current line. With small channel heights the problem of saturation might exist in avoiding saturation in certain parts of the magnetic circuit. In both cases the equations mentioned in this report are applicable. Moreover, preparations were made to describe the electrical working conditions of the MHD generator. By limiting operation to small slips and by implying saturation, it is possible to define impedances, which, in principle, shows that the working condition of an MHD generator has some analogy to that of the conventional induction generator. A corresponding equivalent circuit could also be developed. The power and the losses are calculated. (auth)

35005 PROPERTIES OF THERMIONIC DIODE WITH SELF-CONTAINED DISCHARGE PLASMA. Morgulis, N. D.; Korchevoi, Yu. P. At. Energ. (USSR), 18: 447-51 (May 1965). (In Russian)

Studies are made of the physical properties of a thermionic diode operating with a self-contained discharge plasma of cesium and mercury vapors. It is shown that such a diode has an increased electromotive force and voltage output which primarily depend on the temperature of plasma electrons. Measurements were made of mercury plasma parameters in the interelectrode space of the diode. (tr-auth)

35006 IMPEDANCE OF A MAGNETOHYDRODYNAMIC GENERATOR. Smy, P. R.; Driver, H. S. T. (Univ. of British Columbia, Vancouver). Brit. J. Appl. Phys., 16: 811-20(June 1965).

The electric impedance of a magnetohydrodynamic generator energized by shock-heated argon (Mach 14) was measured as a function of electrode area and external impedance for applied magnetic field strengths from 100 to 10,000 G. It is found that the generator impedance is independent of electrode area over the experimental range of areas ($0.02-1$ cm^2) and is in reasonable agreement with the empirical relation $Z = 30\ I^{-0.87}$. These results are related to a theory of cathode spot conduction. Measurements of the induced voltage with low applied fields show that electrode sheaths do not seriously affect measurements of potential difference in the plasma provided the current densities to the electrode surfaces are less than 10^{-4} Å cm^{-2}. This fact was used to measure sheath potentials and to investigate the conduction properties of these sheaths. (auth)

35007 INVESTIGATIONS ON THE CAESIUM THERMIONIC CONVERTER WITH AN AUXILIARY DISCHARGE. Badareu, E.; Musa, G.; Popescu, D. (Institutul de Fizica, Academia Republicii Populare Romine, Bucharest). Brit. J. Appl. Phys., 16: 845-50(June 1965).

The influence of an auxiliary discharge on the (V,I) characteristic of the cesium-thermionic converter was investigated. The most interesting result appears to be the auxiliary discharge-sustained-arc mode for relatively low-emitter temperatures; under these conditions an auxiliary to output power ratio as low as 6% may be obtained. (auth)

35008 DIRECT ENERGY CONVERSION. p.148-55 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

The development of thermionic, thermoelectric, fuel-cell, and MHD direct-energy-conversion devices is reviewed. (T.F.H.)

35009 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF ELECTRICAL ENERGY. (to Commissariat a l'Energie Atomique). British Patent 992,799. May 19, 1965. Priority date June 13, 1960, France.

A process is described for producing electrical energy by passing a jet of ionized vapor between a first and second electrode that are arranged to lie in succession in the path of the jet and that are maintained at different temperatures. An emf is established between the electrodes without the use of electric or magnetic fields. The easily ionizable vapor is formed from Hg or Cs. The second electrode is cooled sufficiently for the vapor transporting the positive ions to be condensed there and can be provided with fins to assist in the condensation. The apparatus may include two chambers, one in which the jet of vapor is generated from the fluid and a second that contains the electrodes. (B.L.M.)

35010 AN IMPROVED MAGNETOHYDRODYNAMIC GENERATOR IN WHICH SHORT CIRCUIT END EFFECTS ARE REDUCED. (to Avco Corp.). British Patent 995,354. June 16, 1965. Priority date Feb. 2, 1961, United States.

In a MHD generator cooling means are provided capable of reducing the conductivity of at least a portion of the gas downstream of the electrodes within the duct to reduce short circuit end effects adjacent to the furthermost downstream electrodes. The cooling means is effective in the downstream direction for a distance beginning at the furthermost electrodes and extending an amount equal to at least the duct diameter measured at the furthermost electrodes. The cooling means reduces the temperature of a plurality of spaced portions of the space enclosed by the duct. The portions extend substantially across the duct and substantially perpendicular to a plane common to the electrodes, and the conductivity in the portion is reduced to a value sufficient to prevent the flow of current through the portions. An injecting means disposed around at least a part of the duct supplies a non-conducting fluid through supply ports directly into the duct at the furthermost electrodes. Hollow cooling means extend through and are secured to the opposite sides of the duct downstream of the electrodes, and a coolant generator directs the coolant through the hollow members. The supply ports of the injecting means are on the upstream side of the hollow members. (B.L.M.)

35011 MAGNETO-HYDRO-DYNAMIC GENERATOR WITH COOLED DUCT WALLS. (to Brown, Boveri and Co., Ltd.). British Patent 995,523. June 16, 1965. Priority date Feb. 21, 1963, Switzerland.

A MHD generator consisting at least of a combustion chamber and a vertical gas duct with the combustion chamber at the bottom has duct walls built up from coolant-carrying pipes that are disposed substantially parallel to the gas flow. The cross section of the pipes increases in the direction of the gas flow. The wall thickness of the pipes may vary over their length. (B.L.M.)

35012 ALTERNATING CURRENT NUCLEAR MAGNETOGASDYNAMIC ELECTRIC GENERATOR. Oickle, Charles Jr.; Pinsley, Edward A. (to United Aircraft Corp.). German Patent 1,187,745. Feb. 25, 1965. Aug. 28, 1961. Priority date Sept. 12, 1960, United States.

A magnetogasdynamic generator is described in which a fluid stream containing a fissionable material moves through a duct surrounded by moderating material. An a-c current is obtained by systematically varying the fission rate, preferably by moving at least a part of the moderator with respect to the fluid path. (D.C.W.)

35013 ATOMIC POWER PLANT. Sweet, Donald H. U. S. Patent 3,178,631. Apr. 13, 1965. Filed Oct. 23, 1959.

Equipment for deriving electric current directly from an electron source includes a conductive shield substantially enclosing a suitable source, means for keeping the shield at a negative potential sufficient to arrest and collect significant numbers of the electrons emanating from the source, means for returning collected electrons from the shield to the source, and converter units to receive the current flowing in the return means and deliver it in the form of alternating current. Radioactive isotopes produced by atomic fission may be used as a source. (A.G.W.)

Elementary Particles and Radiations

Refer also to abstracts 35225, 35371, 35381, 35449, and 35510.

35014 (BNL-8245) A NOTE ON THE COMPOSITENESS CONDITION IN POTENTIAL THEORY. Rockmore, R. (Lawrence Radiation Lab., Univ. of California, Berkeley and Brookhaven National Lab., Upton, N. Y.). [July 1964]. Contract AT(30-2)-Gen-16. 7p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

A brief discussion is given of the graphical properties of the mapping problems associated with the Mandelstam representation for s-wave potential scattering with one bound state. The consistency condition on the bound state residue ($Z_3 = 0$) is used to put the result of Blankenbecler et al. into obvious Lehmann form. (auth)

35015 (DESY-65/3) ELECTRON-PROTON COINCIDENCE MEASUREMENTS. Behrend, H. J.; Brasse, F. W.; Engler, J.; Ganszauge, E.; Hultschig, H. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany); Galster, S.; Hartwig, G.; Schopper, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Mar. 1965. 24p. (KFK-320). Dep.(mn).

The cross section for elastic electron-proton scattering was measured in the four-momentum transfer region $q^2 = 18$ to 40 f^{-2} at electron scattering angles from 54 to 75°. A polyethylene target was used in the DESY internal beam. Electron-proton coincidences were observed using two quadrupole spectrometers. The separation of elastic and inelastic events is achieved mainly by defining the directions of scattered electrons and recoil protons, whereas the momentum analysis is used only as an additional means to reduce the background. The results obtained are preliminary. The cross sections corrected for bremsstrahlung and hydrogen loss of the CH_2 target are roughly consistent with results calculated from known form factors. (auth)

35016 (IC/65/54) MAGNETIC MOMENTS OF RELATIVISTIC QUARK MODELS OF ELEMENTARY PARTICLES. Lipkin, H. J.; Tavkhelidze, A. (International Centre for Theoretical Physics, Trieste (Italy)). Dep. (mn).

The enhancement of quark magnetic moments by strong binding in a relativistic scalar field is discussed. This enhancement is very sensitive to the type of field or self-consistent potential binding the quarks: no magnetic-moment enhancement appears for the case of binding in a vector field. The difference between the scalar and vector cases is demonstrated, using the extremely simplified model of a single Dirac particle in an external potential constant over all space in an external magnetic field. The Dirac equations are written for this model for the cases of a scalar and a static vector potential. (M.J.T.)

35017 (IC/65/58) THE USE OF DISPERSION METHODS IN THE STUDY OF SYMMETRIES. Fubini, S.; Furlan, G.; Rossetti, C. (International Centre for Theoretical Physics, Trieste (Italy)). June 4, 1965. 19p. Dep.(mn).

Studies were made on problems in the group theoretical approach; consideration was given to estimating the corrections to group theoretical formulas due to symmetry-breaking terms in the hamiltonian and to finding rules for translating group theoretical formulas into the language of experimental data for the case of the dynamical groups. The methods of quantum field theory and dispersion theory are used. Matrix elements and predictions for magnetic moments and form factors for SU(3) symmetry in the first order of symmetry breaking are obtained using commutation operators and completeness; sum rules are obtained by further assumptions. A method is developed for the evaluation of the commutator matrix elements, which preserves covariance at each order of approximation, using the causality condition in the dispersion-relations approach. The generalization of this method to dynamical groups, involving space-time quantum numbers like spin and parity, is discussed. (M.J.T.)

35018 (IFA-CR-50) SEARCH FOR ANOMALOUS π^0 PRODUCTION IN 24-Gev pp COLLISIONS. Cohen, J.; Friedlaender, E. M. (Institutul de Fizica Atomica, Academia R. P. R., Bucharest). Nov. 1964. 9p. Dep. (mn).

An attempt was made to detect in p-p interactions a lack of photons similar to that reported in π-p interactions. A statistical procedure is developed for predicting average numbers of neutral secondaries starting from observed characteristics of the charged prongs and isospin conservation. After suitable corrections, 18 detected e^+e^- pairs associated with 738 inelastic 24 Bev pp-stars, were found consistent with predictions based upon isospin conservation and momentum balance. (auth)

35019 (JINR-E-2120) ITERATION METHOD IN NONRENORMALIZABLE FIELD THEORY. Arbuzov, B. A.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 15p. Dep. (mn).

The iteration method in the nonrenomalizable theory is considered. The linear equation for the vertex in the theory of the interaction between scalar particles and vector ones is taken as an example. The convergence of the iteration procedure and the applicability of the Fredholm method to the full integral equation is provided by the correct choice of the zero approximation. The simple modification of perturbation theory enables one to find the expansion of the vertex in powers of the coupling constant λ and of log $\ln\lambda^2$. (auth)

35020 (JINR-P-2080) PERENORMIROVKA MASSY V TEORII NARVSHENNOI SIMMETRII SL(6). (Mass Renormalization in Broken Symmetry). van Hieu, Nguyen (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 12p. Dep.(mn).

The problem of mass renormalization in the theory of SL(6) symmetry is treated in the framework of Lagrangian formalism. (auth)

35021 (JINR-P-2091) K VOPROSU O VYSSHIKH SIMMETRIYAKH V KVANTOVOI MEKHANIKE. (On Higher Symmetries in Quantum Mechanics). Winternitz, P. (Vinternitts), Mandrosov, V.; Smorodinskii, Ya. A.; Uglirzk, M.; and Frish, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 7p. Dep.(mn).

All potentials demonstrating a higher symmetry i.e., a symmetry group not directly connected with the geometry of the problem are considered in a two dimensional quantum mechanical model. Four types of potentials are found, the symmetry group of which is SU(2), containing the previously known potentials as special cases (Coulomb potential and harmonic oscillator). (auth)

35022 (JINR-P-2102) METOD BUTSTRAPA I POLYUSA PEDZHE. (Bootstrap Method and Regge Poles). Kuetsin'ski, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 17p. Dep.(mn).

A "bootstrap" method is proposed where the resonances

are treated as Regge poles. The Khuri representation is used to describe the contribution from Regge poles. This enables us to factorize the threshold behavior of the partial wave amplitude in such a way that its asymptotic behavior is not spoiled. The unphysical singularities of the so obtained reduced partial wave amplitude are determined by the contributions from the crossed-channel Regge poles. An approximate method is described to calculate these contributions. The possibility of application of this method in a scheme of new form of the strip approximation is discussed. (auth)

35023 (JINR-P-2111) K VOPROSII O RASSEYANII S-VOLN NA SISTEME, SOSTOYASHCHEI IZ NESKOL'KIKH RASSEIVATELEI. (On S-Wave Scattering on a System Consisting of Several Scatterers). Baryshevskii, V. G.; Lyuboshits, V. L.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics and Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 16p. Dep.(mn).

A paradox is considered which concerns the application of the optical theorem to the S-wave scattering on two fixed centers. A way out is in a consistent account of multiple scattering. Exact formulae are obtained for the effective amplitudes describing the S-wave scattering on several fixed centers with account of the spin flip and inelastic processes. (auth)

35024 (JINR-P-2117) O PERENORMIROVKE MASSY V OBOBSHCHENNOI TEORII POLYA. (On Mass Renormalization in Unified Field Theory). Mir-Kasimov, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 12p. Dep.(mn).

The polarization operator in the second order of the pseudoscalar meson theory generalized to the case of momentum space of constant curvature is taken as an example to study the boson mass renormalization. It is shown that in the theory under consideration the spreading of the particle mass occurs as a result of renormalization. (auth)

35025 (JINR-P-2124) GRUPPA SU(3) V TEORII ELEMENTARNYKH CHASTITS. I. SIL'NYE I ELEKTROMAGNITNYE VZAIMODEISTVIYA (OBZOR). (Group SU(3) in the Elementary Particle Theory. I. Strong and Electromagnetic Interactions (Review)). Kadyshevskii, V. G.; Muradyan, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 36p. Dep.(mn).

A review of the lectures given in the autumn of 1964 at a special seminar devoted to the problems of unitary symmetry is presented. Applications of the group SU(3) to the theory of strong and electromagnetic interactions are considered. The exposition of the material is given on the basis of the unified method – the Clebsch-Gordan expansion and Wigner-Eckart theorem. (auth)

35026 (JINR-P-2130) ELEKTROMAGNITIYE SVOISTVA PREDSTAVLENIYA 70 V SKHEME SU(6). (Electromagnetic Properties of Representation 70 in the SU(6)-Scheme). Ti, Kao; Tkachev, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 11p. Dep.(mn).

The electromagnetic current of the 70-plet is obtained under the assumption that it is transformed as a representation 35 of the group SU(6). Its reduction with respect to the subgroup SU(3) × SU(2) is used to single out the electric and magnetic components of the current. It is obtained that the magnetic moments of the particles of the 70-plet are expressed through one constant. Some of the relations between the magnetic moments are indicated. Another method of getting these relations with the help of the magnetic moment operator is considered. (auth)

35027 (JINR-P-2137) K VOPROSU O MASSOVYKH FORMULAKH V TEORII SU(6)-SIMMETRII. (On Mass Formulae in the SU(6)-Symmetry Scheme). Achasov, N. N.; Kadyshevskii, V. G.; Muradyan, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 7p. Dep.(mn).

Mass formulas for an arbitrary multiplet are obtained. The splitting of 35- and 56-plets is treated in detail. (auth)

35028 (JINR-P-2140) UCHET ZAKONOV SOKHRANENIYA ENERGII I IMPUL'SA V NEUPRUGIKH VZAIMODEISTVIYAKH V METODE MONTE-KARLO. (An Account of Energy and Momentum Conservation Laws in Inelastic Interactions in the Monte-Carlo Method). Mal'tsev, V. M.; P'yanov, I. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 15p. Dep.(mn).

A method is given of finding the magnitudes and directions of momenta of n particles emitted in the process of the inelastic interaction of two particles. This method assumes the use of experimental data on the momentum and angular distributions of particles. It is immediately applicable for calculating the intranuclear cascade. (auth)

35029 (JINR-P-2143) ROZHDENII $W^{\pm}$-MEZONOV PRI ANNIGILYATSII POLYARIZOVANNYKH PROTONOV I ANTIPROTONOV. (Production of $W^{\pm}$-Mesons by the Annihilation of Polarized Protons and Antiprotons). Doan Nhuong; Sadykhov, F. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 8p. Dep.(mn).

The production of intermediate mesons by the annihilation of arbitrarily polarized proton and antiproton is considered (in the one-photon approximation). The cross section obtained allows evidence on the imaginary and real part of the complex form factors of the proton to be obtained. (auth)

35030 (JINR-P-2162) RASSEYANIE π^--MEZONOV S IMPUL'SOM 4 Gev/c NA ELEKTRONAKH. (Scattering of 4-Gev/c Negative Pion on Electrons). Grishin, V. G.; Kistenev, E. P.; Tzung, Mu (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 10p. Dep.(mn).

The scattering of 4-Bev/c negative pions on electrons was studied. The composition of the beam of primary particles incident on the chamber was determined. The total contamination of muons and electrons in the beam was found to be $(10.3 \pm 2.1)\%$. The differential π_e-scattering cross section was obtained, in agreement with the results of the theoretical calculation for the pion scattering on the point electron. A conclusion can be drawn that $r_\pi \leq 6{,}6 \cdot 10^{-13}$cm. (auth)

35031 (LAL-1131) ON THE INELASTIC ELECTRON-DEUTERON SCATTERING AND THE RESCATTERING CORRECTIONS. Bosco, B.; Grossetete, B.; Quarati, P. (Laboratoire de l'Accelerateur Lineaire, Univ. de Paris, Orsay (France) and Cagliari Univ. (Italy). Istituto di Fisica). Apr. 1965. 45p. Dep.(mn).

Inelastic electron-deuteron scattering is examined on the basis of the recent Orsay experiments. The expression for the differential cross section is derived on a general basis. The rescattering corrections predicted by different methods are compared extensively, and their effects on the nucleon form factors discussed. (auth)

35032 (LAL-1137) SEARCH FOR AN EXCITED ELECTRON OF MASS IN THE RANGE OF SEVERAL HUNDRED Mev. Betourne, C.; Ngoc, H. Nguyen; Jorba, J. Perez Y; Van, J. Tran Thanh (Laboratoire de l'Accelerateur Lineaire, Univ. de Paris, Orsay (France)). May 1965. 7p. Dep.(mn).

A search was performed for the heavy electron (e'), suggested by Low to explain deviations from simple quantum electrodynamics in electron photoproduction. The observation of the recoil proton in the reaction $e + p \rightarrow p + e'$, $e' \rightarrow e + \gamma$, should reveal the e' as a sharp-missing mass peak in the excitation curve. An attempt was made to detect the e' or to put an upper limit on the coupling (λ) in the range 120 to 570 Mev, using the maximum angle technique and ordinary excitation technique and initial energies from 280 to 980 Mev. No effect was found within the criteria chosen for the existence of a significant enhancement; a lower limit of the quantity $\lambda^{-2} = \sigma_{theor}(\lambda = 1)/\sigma_{expt}$ as a function of the mass for the two techniques is given. (M.J.T.)

35033 (UCRL-14202) PION-PROTON INELASTIC DATA. Rosenberg, R. L.; Roper, L. D. (Lawrence Radiation Lab., Univ. of California, Livermore). May 21, 1965. Contract W-7405-eng-48. 18p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Tables of $\pi^+ + p$ and $\pi^- + p$ total and partial inelastic cross sections known in August, 1964 are listed up to ~1 Bev. The good agreement between the London-Livermore π-p phase shifts and the total inelastic cross sections is shown. (auth)

35034 OBSERVATIONS ON THE CV MODEL. Zingl, Harald F. K. (Universitat, Graz). Acta Phys. Austriaca, 19: 217-21(1965). (In German)

A model is presented for nucleon form factors, which is based on the assumption that the meson(W) of weak interactions exists. A value of 1.35 Bev is assumed for its mass. Possible supplementary isovectorial form factors are presented. The significance of the model proposed is discussed. (J.S.R.)

35035 LOW-ENERGY $\bar{K}$-N SCATTERING AND THE Y_1^* 1405-Mev RESONANCE. Kolb, Gerhard (Kernforschungsanlage, Julich, Ger.). Acta Phys. Austriaca, 19: 229-35(1965). (In German)

The I = 0, π-Σ resonance Y_1^* with a mass of 1405 Mev and the width of 50 Mev was explained as an s-wave "virtual bound state resonance" in the I = 0, $\bar{K}$-N channel. As a dynamic model, the zero-range approximation modified by vector meson exchange of ρ and ω^0 in the elastic K-N and π-Σ channels, and the scattering matrix was represented in the form T = N/D. It is essential that the interpretation of the resonance is only reconciled with complex $\bar{K}$-N scattering lengths of the type of the Dalitz (b) solution A = a + ib = (-1.8 + i 0.6) Fermi, with $i = \sqrt{(-1)^{0.5}}$. (tr-auth)

35036 REMARKS ON THE DISTINCTION BETWEEN ELEMENTARY PARTICLES AND COMPOSITE PARTICLES. Diu, Bernard (Universite de Paris, Orsay, France). Ann. Inst. Henri Poincare, Sect. A, 1: 147-232(1964). (In French)

Some problems related to the definition of elementary and composite particles are studied and in this respect the two main directions in which theoretical high energy physics research is being developed are examined. A possible general definition of an elementary particle is discussed and some of the difficulties that may arise while applying it are underlined by studying the Lee model from this point of view. The attempts are made to bring out a symmetry of strong interactions wider than that of isospin. Starting from plausible though yet badly understood hypotheses, it is possible, for the three simple Lie groups of rank 2, to prove mass relations between the different particles entering the same supermultiplet; these mass relations are then sufficient to discard C_2 and G_2 and keep only SU_3 as a possible approximate symmetry group for strong interactions. The bootstrap theory is considered; this theory states that there exist no elementary particles, but only composite ones. One of the practical methods of calculation which have been proposed to work out bootstrap is applied to the mesonic scattering amplitudes $\pi + \pi$, $\pi + K$ and K + K; the results are quantitatively poor, but the qualitative predictions seem up to now correct. (auth)

35037 ON THE COUPLING OF 3 ANGULAR MOMENTA. Chakrabarti, A. Ann. Inst. Henri Poincare, Sect. A, 1: 301-27(1964). (In French)

In the problem of coupling of three angular momenta (j_1,j_2,j_3), it is proposed to classify the states to the eigenvalues of the operator $Z = (\vec{J}_1 \times \vec{J}_2).\vec{J}_3$, along with those of $\vec{J}_1^2$, $\vec{J}_2^2$, $\vec{J}_3^2$, $(\vec{J}_1 + \vec{J}_2 + \vec{J}_3)^2$, $(J_1^2 + J_2^2 + J_3^2)$. Z replaces the usual choice of one of the operators $(\vec{J}_a + \vec{J}_b)^2(a,b, = 1,2,3)$, connected through the Racah coefficients. The great advantage of this method lies in the fact that the eigenstates thus obtained possess remarkable symmetry properties under particle permutations. This fact practically eliminates the problem of constructing final state vectors of required symmetries in the 3-particle problem. (auth)

35038 RELATIVISTIC FORMALISM OF POLARIZATION IN A TWO-COMPONENT DESCRIPTION OF SPIN-½ PARTICLES. Gervais, Jean-Loup (Universite de Paris, Orsay, France). Ann. Inst. Henri Poincare, Sect. A, 1: 385-402(1964). (In French)

The two-component theory of spin ½ particles previously proposed by Brown is considered. The relativistic invariance of that theory, in which the wave function is an eigenvector of γ^5, is studied by introducing the two-component representation of the Poincaré group which describes the transformation laws of the free states. This allows the polarization formalism to be obtained by using the general theory of relativistic spin, and the formula necessary for the study of polarization effects in scatterings to be derived. The formulas appear to be simpler than in the Dirac theory since they do not contain any projector upon the positive-energy states; the positive and negative energy states being automatically separated in the two-component formalism. Finally the second order Compton effect is studied to show how the formalism may be used practically. (auth)

35039 SYMMETRY GROUPS AND INTERNAL INVARIANCE GROUPS IN THE THEORY OF STRONGLY INTERACTING PARTICLES. Halbwachs, Francis; Mebkhout, Mohammed (Faculte des Sciences, Marseille). Ann. Inst. Henri Poincare, Sect. A, 2: 1-20(1965). (In French)

A parallel treatment is proposed for the ordinary symmetry concept governing the interactions of strongly interacting particles, and for the idea of the invariance of an internal dynamics ascribed to a geometrical model of an extended structure for elementary particles. After a short survey of the well-known pion-nucleon treatment, where both points of view are equivalent, this conception is applied to the relativistic rotator theory, in order to derive an interaction Hamiltonian consistent with the invariance group of the model. Some qualitative outcomes are obtained concerning the unobserved states provided by the theory, and their unappearance is interpreted. (auth)

35040 ELASTIC π-p SCATTERING AT 4.0 Gev/c. Zlateva, A.; Markov, P.; Todorov, T., et al. Compt. Rend. Acad Bulgare Sci., 16: 581-3(1963).

The photoemulsion method was used to study elastic π-p scattering at 4.0 Bev/c. A total of 164 elastic events were identified. The differential cross-sections in the region 30 to 150 in the cms are tabulated. They are compared with the corresponding values calculated according to C. Lovelace. The differences between the experimental and calculated values (data) increase with the scattering angle. (auth)

35041 TOWARDS THE QUARK. Charap, J. M. Discovery, 24: No. 6, 16-21(June 1965).

A review is given of the field of elementary particles. Matter and fields, strange particles, selection rules, symmetry in weak interactions, the discovery of Ω^-, and the existence of quarks are discussed. (C.E.S.)

35042 DIRAC'S MONOPOLE AND SOME PROBLEMS OF NEUTRINO PHYSICS AND GEOPHYSICS. Okulov, Yu. I. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR)(English Transl.), 4: 780-9(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1002-(1964).

It is shown that Dirac's monopole must be pseudoscalar. The interaction of an electron with the external electromagnetic field, created by a scalar magnetic charge, is studied. From the analysis it follows that the interaction is not invariant with respect to space reflection and that the magnitude of the scalar magnetic charge must be less than the electron charge. This makes it possible to assume that a neutrino has a scalar magnetic charge other than zero. It is shown that the basic considerations of the four-component neutrino theory do not contradict this hypothesis. The magnetic charge of the neutrino is estimated from experimental data on the size of the ionization cross section as particles pass through matter. Some geophysical aspects of a neutrino with a magnetic charge are discussed. (auth)

35043 CYCLOTRON RADIATION CHARACTERISTICS AS A FUNCTION OF THE ORIENTATION OF THE MAGNETIC DIPOLE. Lotova, N. A.; Markeev, A. K. (Lebedev Inst. of Physics, Moscow and Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR)(English Transl.), 4: 790-3(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1015-(1964).

Expressions for Stokes's parameters in a dipole magnetic field are derived for cyclotron radiation with a dipole inclined at an arbitrary angle to the line of sight. The degrees of polarization, ellipticity, and of the relative change in radiation intensity are calculated for various angles of inclination of the dipole. (auth)

35044 BREMSSTRAHLUNG OF A MAGNETIC SCALAR CHARGE. Okulov, Yu. I. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR)(English Transl.), 4: 861-2(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1111-(1964).

An experiment is proposed by which the hypothesis that the neutrino has a non-zero scalar magnetic charge can be verified by detecting bremsstrahlung from the magnetic charge. An expression for the energy loss by bremsstrahlung of a scalar magnetic charge moving in a homogeneous magnetic field perpendicular to its trajectory is derived. Relations for the radiation frequency and emission angle are also obtained. Numerical results are included for a given set of conditions. (D.C.W.)

35045 ABOUT THE SPACE DISTRIBUTION OF LEPTONS PRODUCED IN COLLISIONS OF FAST PARTICLES. Fakirov, D. Godishnik Sofiiskiya Univ., Fiz. Mat. Fak., Kniga, 3-Khim., 56(1961/62), 93-117(1963).

The muon and electron decays of charged pions are considered. Landau's theory of manyparticle production in collisions of fast particles is applied. Analytical expressions are found for the spatial distributions of decay products of high energy pions—neutrinos and muons. The obtained numerical results are systematized in tables and diagrams. (L.B.S.)

35046 SYMMETRY BREAKING TWO-BODY PHOTONIC DECAY OF VECTOR MESONS AND UNITARY SYMMETRY. Iwao, S. (Universitaet, Bern). Helv. Phys. Acta, 38: 251-4(May 15, 1965).

Two-body photonic decay of vector mesons is investigated in the symmetry-breaking unitary-symmetry model of Gell-Mann and Ne'eman. Three equations are derived from nine decay amplitudes under charge conjugation invariance. These relations allow one to determine the ω-ϕ mixing angle when enough experimental information is available. A method to study this problem is suggested. (auth)

35047 THE DETERMINATION OF THE INTERACTION CROSS SECTION FOR ELECTRON PAIR PRODUCTION IN THE FIELD OF AN ELECTRON BY GAMMA QUANTA OF ENERGY 2.75 Mev. Frei, Ch. J.; Staub, H. H.; Stuessi, H. (Universitaet, Zurich). Helv. Phys. Acta, 38: 262-78(May 15, 1965). (In German)

The integral pair production cross section in the field of an electron near the threshold (E_γ = 2.75 Mev) was measured. The method applied is based upon the evaluation of the ratio of the electronic pair production cross section to the nuclear cross section. The measurement of this ratio can be achieved by determining the combined rate of the pairs and triples in three different materials. In the experiment beryllium, aluminum, and selenium were used. Representing the integral pair production cross-section per atom by $\sigma = \alpha r_0^2(\Gamma_e Z + \Gamma_n Z^2 + \Gamma_m Z^4)$, it is found that $\Gamma_e = 0.023 \pm 0.013$. This result lies between the theoretical values given by Borsellino and Votruba but tends to Votruba's lower value. (auth)

35048 ELASTIC SCATTERING OF PROTONS BY DEUTERONS AT SMALL ANGLES AT 6.2 Gev. Zlatanov, Z. M.; Kanazirski, H. M.; Markov, P. K., et al. Izv. Fiz. Inst. s Aneb. Bulgar. Akad. Nauk, 11: 101-4(1963).

In order to study the elastic scattering of protons by deuterons at energy 6.2 Bev, an emulsion stack was irradiated on the synchrophasotron perpendicularly to the surface of the layers. The density of the primary beam was $(4.13 \pm 0.08) \times 10^5$ proton/cm^2. The NIKFI-BR emulsion was used soaked in heavy water. The density of the deuterium atoms at the moment of irradiation was 4.78×10^{22} atoms/cm^2. The area of the emulsion was examined. In 1.0 cm^2 of emulsion 467 two-prong stars were found, in 140 cases out of them an elastic p-d scattering was identified. The differential cross-section of elastic scattering was established in the angle interval 1.5 to 7.5° in the cms. Its value at forward scattering was found to be 500 mb/sterad. The elastic scattering cross-section in the interval 1.5 to 7.5° was 8.41 ± 0.73 mb. The screening factor of the deuteron was found on the basis of the data to be 9%. (auth)

35049 ELASTIC SCATTERING OF PROTONS AT 6.2 Gev. Zlateva, A. J.; Markov, P. K.; Cernev, H. M. Izv. Fiz. Inst. s Aneb. Bulgar. Akad. Nauk, 11: 105-20(1963).

The elastic scattering is studied of 6.2 Bev protons received in the synchrophasotron in three photoemulsion stacks—A, B, C with BR emulsions of 400 mk thickness. The emulsion in stack B was soaked in water. The incident proton stack was normal to emulsion's surface, and had densities of $(6.87 \pm 0.11 \times 10^5$, $(6.81 \pm 0.12) \times 10^5$ and $(4.84 \pm 0.07) \times 10^5$ proton/cm^2. 325 cases were discovered of elastic scattering, and the differential cross-sections of that process were determined in separate angle-intervals in the cms. The elastic scattering cross-section of the protons determined on the basis of the data and of those given by Cork et al. turned to be (9.8 ± 0.9) mb. The average value of the interaction radius resulting also from the combined data is $(0.94 \pm 0.10) \times 10^{-13}$ cm, while the present data alone lead to $(1.24 \pm 0.10) \times 10^{-13}$ cm. The coefficients in the analytic expression of the differential cross-section as a function of the square of the transverse momentum transfer was determined by the method of least squares. The following results were obtained: a = 15.0 ± 2.2(Bev/c)$^{-2}$, b = 0.1 ± 0.3 (data of Markov et al.); a = 7.7 ± 1.0(Bev/c)$^{-2}$, b = 0.5 ± 0.3 (data of Cork et al.); a = 7.7 ± 0.7(Bev/c)$^{-2}$, b = 0.4 ± 0.1 (combination of these two sets of data). (auth)

35050 ON SOME QUESTIONS CONNECTED WITH THE ALGEBRAISATION OF THE EQUATIONS OF PION-NUCLEON AND PION-PION SCATTERING. Nedjalkov, I. Izv. Fiz. Inst. s Aneb. Bulgar. Akad. Nauk, 11: 121-37 (1963).

Making use of the principles of analysis, cross-symmetry, and unitarity, an algebraic system is obtained for the description of certain processes of scattering in pion-nucleon and pion-pion scattering. This system is found to be sufficiently simple for calculations and might also be used to explain certain properties of the solutions. (auth)

35051 REPRESENTATION OF THE SCATTERING AMPLITUDES. Nedjalkov, I. P. Izv. Fiz. Inst. s Aneb. Bulgar. Akad. Nauk, 11: 179-92(1963).

The different ways of expressing the dependence of the scattering amplitude h(z) on its argument z are called the representation of the scattering amplitude. In the component representation h(z) is expressed as a sum of more elementary functions. The component representation is proved to be unique. The determination of h(z) in regions with singularities is carried out in cases which are inaccessible for the Oehmes method. In suitable representations algebraic equations of the Low type are derived. These equations may have an advantage over dispersion ones because the usual analytical properties of the scattering amplitude are not necessary for their derivation. The possibilities of a natural classification of the scattering amplitudes are discussed. (auth)

35052 TENSORIAL DESCRIPTION OF NEUTRINOS. Penney, R. (Ford Motor Co., Dearborn, Mich). J. Math. Phys. (N. Y.), 6: 1026-8(July 1965).

It is shown that the equation $T^{\omega}_{\nu}(T^{\rho\lambda} + T^{\rho\lambda}_{\tilde{a}})|_{\rho} + T^{\mu\omega}(T_{\mu\nu} - T_{\tilde{a}\mu\nu})^{\lambda} = 0$, where $T_{\mu\nu}$ is a null antisymmetric tensor and $T_{\tilde{a}}$ its dual, is necessary and sufficient that there be a two-component Majorana neutrino field. That is, the neutrino field may be described solely in terms of tensorial quantities and operations, without the need for spinors. (auth)

35053 BOSONS AND FERMIONS. Penney, R. (Ford Motor Co., Dearborn, Mich.). J. Math. Phys. (N. Y.), 6: 1031-4(July 1965).

It is proven that one cannot construct boson creation and annihilation operators from a finite number of fermion operators. The proof follows from the isomorphism of the fermion algebra and the algebra of Dirac matrices. (auth)

35054 FUNCTIONAL EXPANSION IN PERATIZATION THEORY. Fried, H. M. (Brown Univ., Providence). J. Math. Phys. (N. Y.), 6: 1076-82(July 1965)

A functional peratization expansion is defined in the charged vector meson theory of weak interactions. The simplest approximation is carried through and shown to yield an allowed lepton–lepton scattering amplitude, properly damped on the light cone. A basic deficiency in this procedure is the absence of any criteria for the estimation of the character and size of successive corrections. (auth)

35055 SCATTERING BY SINGULAR LOGARITHMIC POTENTIAL. Aly, H. H.; Riazuddin; Zimerman, A. H. (Univ. of Rochester, N. Y.). J. Math. Phys. (N. Y.), 6: 1115-17(July 1965). (UR-875-50)

Potential of the form $(gr^{-4}\ln^2 r - g^{\frac{1}{2}}r^{-3})\theta(r - r_0)$ is considered in connection with the applicability of peratization technique. The advantage of this potential is the fact that while it is dominated by a logarithmic part near the origin, the exact solution of the zero-energy and s-wave Schrödinger equation is obtained in a closed form. It is shown that the peratization technique gives the correct answers. (auth)

35056 EVALUATION OF FEYNMAN'S FUNCTIONAL INTEGRALS. Zimmerman, Robert L. (Univ of California, Livermore). J. Math. Phys. (N. Y.), 6: 1117-24 (July 1965).

Several relations for Feynman's functional integrals are derived. From these relations, two different schemes for approximating Feynman's functional integral are constructed. The methods of approximation are expected to converge sufficiently rapidly in many cases so that only the lowest orders of the approximation are required to give reliable answers. (auth)

35057 SOLUTION OF THE INTEGRAL EQUATION FOR Vθ SCATTERING IN THE LEE MODEL. Sommerfield, Charles M. (Yale Univ., New Haven). J. Math. Phys. (N. Y.), 6: 1170-2(July 1965).

A deductive procedure is presented for obtaining the solution of the integral equation for Vθ scattering in the Lee model. (auth)

35058 UPPER BOUND FOR THE DOUBLE SPECTRAL FUNCTION IN POTENTIAL SCATTERING. Thompson, Charles. J. Phys. Soc. Japan, 20: 643-8(May 1965).

For potentials V(z) holomorphic in Rez > 0 and bounded by $|V(z)| < (K/|Z|^{\rho}), \rho < 2$ for $|Z| \leq 1$ and $|V(z)| < (K/|Z|^{\gamma})$ $e^{-a\mathrm{Re}z}$, $r > 7/4$ for $|Z| \geq 1$ it is shown that the double spectral function $\rho(s,t)$ is acontinuous function of s and $t \geq 0$, $t > 0$, and an upper bound is obtained for it. This upper bound shows clearly that the double integral of the Mandelstam representation in fact exists and defines an analytic function of s and t in two cut planes. It is indicated how to generalize these results to the case when $\rho(s,t)$ is no longer a function but a distribution. (auth)

35059 BARYON RESONANCES PRODUCED IN WEAK INTERACTIONS AND UNITARY SYMMETRY. Rekalo, M. P. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). JETP Letters (USSR) (English Transl.), 1: 9-12(Apr. 1, 1965).

On the basis of unitary symmetry the relations between the amplitude for the formation of baryon resonances belonging to the irreducible representation SU(3) of dimensionality 10 are investigated upon interaction between an antineutrino and nucleons. (J.F.P.)

35060 MAGNETIC MOMENTS OF BARYONS AND SU(6) SYMMETRY. Akhiezer, A. I.; Rekalo, M. P. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). JETP Letters (USSR) (English Transl.), 1: 29-31(Apr. 1, 1965).

The influence of moderately strong interactions on the relations between the magnetic moments of baryons is ascertained. It is shown that the relation is conserved between $\mu(p)$ and $\mu(n)$ even when account is taken of moderately strong interaction. (J.F.P.)

35061 SU(6) SYMMETRY AND ELECTROMAGNETIC BARYON MASS SPLITTING. Volkov, D. V. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). JETP Letters (USSR) (English Transl.), 1: 32-7(Apr. 1, 1965).

A structure of electromagnetic interactions is proposed leading to the splitting of the masses of particles within baryon multiplets. (J.F.P.)

35062 RENORMALIZATION OF CONSERVED CURRENTS BY SYMMETRY BREAKING. Polyakov, A. M. (Inst. of Physics and Tech., Moscow). JETP Letters (USSR) (English Transl.), 1: 55-7(Apr. 15, 1965).

Since the strange current and octet breakdown are vectors from the point of view of the V-isogroup, the change in the V spin current is considered when V symmetry is broken. (J.F.P.)

35063 TRANSFORMATION PROPERTIES OF THE WEAK INTERACTION LAGRANGIAN AND OF THE S AMPLITUDE OF HADRON DECAYS OF HYPERONS IN SU(6) SYMMETRY. Matinyan, S. G. (Inst. of Physics, Academy of Sciences, Georgian SSR). JETP Letters (USSR) (English Transl.), 1: 57-60(Apr. 15, 1965).

The degree to which the relation between the S amplitudes of hadron decays of certain hyperons, are stable against the transformation properties of the lagrangian (or the corresponding spurion) of hadron weak interactions is considered. (J.F.P.)

35064 ELECTROMAGNETIC DECAYS OF MESONS IN THE QUARK MODEL. Azimov, Ya. I., Anisovich, V. V.; Ansel'm, A. A.; Danilov, G. S.; Dyatlov, I. T. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Letters (USSR) (English Transl.), 1: 72-5(Apr. 15, 1965).

Attention is drawn to the possibility of making several predictions, which could be experimentally verified due to the application of SU(6) symmetry and of the quark model to an analysis of electromagnetic decays of mesons. (J.F.P.)

35065 HARD VAVILOV-CHERENKOV RADIATION IN A SINGLE CRYSTAL. Rivlin, L. A. JETP Letters (USSR) (English Transl.), 1: 79-81(May 1, 1965).

A discussion of resonant modes by electromagnetic oscillations of x-ray frequency shows that the hard Cherenkov radiation produced in a single crystal consists of lines coinciding with the resonant modes for which the synchronism condition is satisfied. The natural frequencies in the direction of propagation of the resonant modes can be found from the condition for crossing of the Ewald propagation sphere with not less than two reciprocal lattice points. An example is given. (J.F.P.)

35066 ELECTROMAGNETIC PROPERTIES OF MESONS IN SU(6) SYMMETRY. Rekalo, N. P. (Physicotechnical Inst., Academy of Sciences, Ukrainian SSR). JETP Letters (USSR) (English Transl.), 1: 91-2(May 1, 1965).

The relation between the magnetic moments of charged vector mesons and the amplitudes of the decay, vector meson → pseudoscalar meson + γ within the framework of SU(6) symmetry is investigated. (J.F.P.)

35067 RENORMALIZATION OF BARYON VECTOR CURRENT BY BREAKING OF SU(6) SYMMETRY. Gedalin,

E. V.; Kancheli, O. V.; Matinyan, S. G. (Inst. of Physics, Academy of Sciences, Georgian SSR). JETP Letters (USSR) (English Transl.), 1: 93-5(May 1, 1965).

An analog of the Ademollo-Gatto theorem in SU(6) symmetry is obtained. In deriving this theorem, the vector current of the baryons belonging to the presentation $56(B^{\alpha\beta\gamma})$ of the SU(6) group are transformed in accordance with representation 35. (J.F.P.)

35068 RESONANCES IN ELEMENTARY PARTICLE PHYSICS. Rashid, A. M. Harun-ar Nucleus (Lahore). 2: No. 1, 23-6(Jan.-Mar. 1965).

A review is presented of resonances in elementary particle physics, and their significance and method of discovery are discussed. All presently available information on the baryonic and mesonic resonant states are tabulated. (L.B.S.)

35069 ON THE QUANTUM NUMBERS OF STRONGLY INTERACTING PARTICLES. Lichtenberg, D. B. (Indiana Univ., Bloomington). Nuovo Cimento (1), 3: Suppl., 22-42 (1965).

The extent to which theoretical relations among elementary particles are supported by experimental evidence is considered. Conclusions reached by other workers are given; and certain conservation laws believed to hold in particle interactions are used. The discussion includes spin, statistics, intrinsic parity, theoretical arguments, and experimental evidence. (J.F.P.)

35070 Q-VALUE DISTRIBUTIONS OF PION-LAMBDA PAIRS IN K^--p COLLISIONS. Gautam, V. P.; Agarwal, B. K. (Allahabad Univ., India). Nuovo Cimento (1), 3: Suppl., 43-7(1965).

An investigation is made of the predictions of the isobar model and statistical theory, compared with experimental data at various energies for the reaction $K^- + p \rightarrow \Lambda + \pi^+ + \pi^-$. It is found that the isobar model is favored over statistical theory. (J.F.P.)

35071 REDUCTION COEFFICIENTS OF THE PRODUCT $8 \otimes 8 \otimes 8$ OF SU_3. Dothan, Y.; Harari, H. (Israel Atomic Energy Commission, Yavne). Nuovo Cimento (1), 3: Suppl., 48-99(1965).

Reduction coefficients for the triple product $8 \otimes 8 \otimes 8$ for the SU_3/Z_3 symmetry model are given. Classification schemes for the irreducible components of $8 \otimes 8 \otimes 8$, definitions and conventions, and tables of the reduction coefficients are included. It is noted that this model describes quite nicely various phenomena of elementary particle physics. (J.F.P.)

35072 ω-MESON PRODUCTION VIA ρ-EXCHANGE IN PION-NUCLEON INTERACTIONS. Berzi, V. (Universita, Milan). Nuovo Cimento (1), 3: Suppl., 100-14 (1965).

Processes are considered which for G parity conservation cannot have contributions from one meson (π) exchange, since this becomes negligible when compared to the contributions of vector-particle exchange. Thus in the one-particle exchange a dominant contribution from ρ exchange is expected. The reactions $\pi + N \rightarrow \omega + N$ and $\pi + N \rightarrow \omega + N_{33}$ are examined assuming they are dominated by ρ-exchange diagrams. (J.F.P.)

35073 SINGLE PION PRODUCTION AND MULTIPLE PION ANNIHILATIONS IN $\bar{p}$-p INTERACTIONS AT 7 Gev/c. Ferbel, T.; Firestone, A.; Johnson, J.; Sandweiss, J.; Taft, H. D. (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). Nuovo Cimento (10), 38: 12-18(July 1, 1965).

A preliminary study of single pion production with no annihilation and multiple pion annihilation in antiproton-proton interactions at 7 Bev/c indicates that the single pion production cross section is 5.6 ± 1.2 mb, and the multipion annihilation cross section is ~24 mb. Although there is strong evidence for resonance production in the one pion production channels, these states do not appear to be dominated by any single resonance. Resonance production in the annihilation channels is small compared to rates observed at lower energies. (auth)

35074 MULTIPLE PION PRODUCTION (WITHOUT ANNIHILATION) IN $\bar{p}$-p COLLISIONS AT 7 Gev/c. Ferbel, T.; Firestone, A.; Johnson, J.; Sandweiss, J.; Taft, H. D. (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). Nuovo Cimento (10), 38: 19-25(July 1, 1965).

Preliminary results of an investigation of multiple pion production without annihilation in antiproton-proton collisions at 7 Bev/c exhibit highly peripheral characteristics. The experimental distributions in the reaction $\bar{p} + p \rightarrow \bar{p} + p + \pi^+ + \pi^-$ are consistent with a one-pion-exchange mechanism particularly for low four-momentum transfers. The cross section for multipion production without annihilation is ~20 mb. (auth)

35075 $\pi^{\pm}$-p AND p-p ELASTIC SCATTERING AT 8.5, 12.4 AND 18.4 Gev/c. Harting, D. (CERN, Geneva); Blackall, P.; Eisner, B. (and others). Nuovo Cimento (10), 38: 60-94(July 1, 1965).

Approximately 60,000 events were collected in a spark chamber experiment at the CERN Proton Synchrotron which studied elastic diffraction scattering of π^--p and p-p at incident momenta of 8.5, 12.4 and 18.4 Bev/c and of π^+-p at 8.5 and 12.4 Bev/c. Magnetic analysis of the incoming and diffraction scattered particle, together with measurement of all angles, permitted each event to be determined as elastic subject to three constraints, so that the inelastic background was rejected with high efficiency, even at the larger momentum transfers. A detailed description of the experimental technique and of the methods of analysis is given. The results, together with data from lower energies, confirm the remarkable energy-independence of the shape of the pion-proton diffraction scattering peak up to $|t| = 1.5$ $(Bev/c)^2$, where t is the square of the four-momentum transfer, over a range of pion energies from 2 to 18 Bev. Proton-proton scattering does however appear to show a shrinking diffraction peak. In general, the data agree with other experiments using both counter and bubble chamber techniques, but some differences do appear. During the experiment, data were taken which set an upper limit of 2×10^{-2} $\mu b/(Bev/c)^2$ on the differential elastic cross-section $d\sigma/dt$ over a range of $|t|$ from 20.9 to 23.4 $(Bev/c)^2$ at 13.4 Bev/c incident pion momentum. (auth)

35076 p-p SMALL ANGLE SCATTERING AT HIGH ENERGY. Baroni, G.; Manfredini, A.; Rossi, V. (Universita, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 38: 95-106(July 1, 1965).

The differential cross-section $d\sigma/d\Omega$ in the c.m.s. for elastic p-p scattering was measured, with the nuclear emulsion technique, for incoming protons of 27.5 Bev/c. The data refer to values of a transferred quadrimomentum $5 \times 10^{-3} < -t < 5 \times 10^{-2} (Bev/c)^2$. From the analysis of the experimental data the ratio between the real and the imaginary parts of the nuclear scattering amplitude was found to be $\rho = -0.23 \pm 0.13$. (auth)

35077 VECTOR MODEL FOR SU_3. Rosen, B. (Stevens Inst. of Tech., Hoboken, N. J.). Nuovo Cimento (10), 38: 246-54(July 1, 1965).

A schematic presentation for the various representations of SU_3 is presented. The results are a generalization of the vector model for SU_2 and O_3. The decomposition of Kronecker products of representations is easily effected by the rules given. (auth)

35078 ON SCHWINGER'S PARAMETRIZATION OF FEYNMAN GRAPHS. Peres, A. (Israel Inst. of Tech., Haifa). Nuovo Cimento (10), 38: 270-84(July 1, 1965).

Schwinger's formula, $(z + i\epsilon)^{-1} = -i \int \exp[ia(z + i\epsilon)]\, da$, is applied to the propagators of Feynman diagrams. All the integrations over internal momenta are performed explicitly, leaving expressions which involve only the auxiliary parameters a_n and the external momenta. It is shown how to modify these formulas so as to switch off adiabatically the interaction outside a given space-time domain. Possible applications of this method to the study of analyticity properties are briefly discussed. (auth)

35079 ON THE STABILITY OF THE PLANE-WAVE HARTREE-FOCK STATE. de Graaf, A. M.; Luzzi, R. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nuovo Cimento (10), 38: 285-90(July 1, 1965).

Considering small deviations from the paramagnetic plane-wave Hartree-Fock state, the condition for the stability of that state is derived using Landau's theory of the Fermi liquid. It is shown that this condition is identical with that derived by other many-body techniques. Comparison is made with Overhauser's theory of giant static spin-density waves. (auth)

35080 THE ELECTROMAGNETIC STRUCTURE OF VECTOR MESONS IN SU_3 SYMMETRY. Flamm, D. (Massachusetts Inst. for Tech., Cambridge). Nuovo Cimento (10), 38: 291-4(July 1, 1965). (MIT-2098-84)

Relations for the magnetic-dipole and electric-quadrupole moments of vector mesons in SU_3 symmetry are given. For the model in which the electromagnetic form factors are dominated by the vector meson pole, the anomalous magnetic moments of vector mesons which belong to an octet in SU_3 are found to be equal to the normal ones. The model also gives expressions for the form factors. (auth)

35081 FORM FACTORS AND POLARIZATION EFFECTS IN NEUTRINO-INDUCED INTERACTIONS. Ketley, I. J. (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 38: 302-15(July 1, 1965).

Form factors analogous to F_C and F_M in nucleon electromagnetic interactions are suggested for the vector and axial-vector currents at the strong vertex in a current-current theory of weak interactions. They are used to compute the cross-section and expressions for the covariant polarization four-vectors for the two final particles in the process $\nu(\bar{\nu}) + \mathcal{N} \rightarrow l + b$ with a view to determining the form factors and testing time-reversal invariance. (auth)

35082 ON THE QUESTION OF CP-INVARIANCE AND A POSSIBLE DIFFERENCE OF θ_V AND θ_A IN HYPERON LEPTONIC DECAYS. Drechsler, W. (Universitat, Heidelberg). Nuovo Cimento (10), 38: 345-55(July 1, 1965).

A comparison of Cabibbo's theory of weak interaction with the recently determined branching ratios for electronic hyperon decays is made, to investigate the influence of a possible CP-violating term $(\mu/2m_B)\sigma_{\mu\nu}q_\nu\gamma_5$ in the decay amplitudes on the accuracy of the determination of the axial vector angle θ_A. Using for the vector angle the experimental value $\theta_V = 0.214 \pm 0.010$, for the case $\mu = 0$ an axial vector angle $\theta_A = 0.35 \pm 0.03$ was obtained being more than three standard deviations larger than θ_V. In the case of maximum CP violation there is again a possible solution with $\theta_A = \theta_V$ for $\mathrm{Re}\,\mu = 0$ and $|\mathrm{Im}\,\mu| = 19 \pm 6$. An imaginary part of this order leads to an observable transversal Λ-polarization in the decay $\Sigma^- \rightarrow \Lambda e^- \bar{\nu}$. The d/f mixing parameter ξ for the axial vector weak interaction is determined to be $\xi = 0.68 \pm 0.04$. This is of the same order as the corresponding mixing parameter for strong pseudoscalar meson to baryon coupling. Finally generalized Goldberger-Treiman relations are used to derive numerical values for pseudoscalar meson-baryon coupling constants. (auth)

35083 PARTIAL-WAVE AMPLITUDES OF THE BARYON-BARYON SCATTERINGS IN THE SU_6 SYMMETRY. Suzuki, M. (Tokyo Univ.). Nuovo Cimento (10), 38: 368-73(July 1, 1965).

The partial-wave amplitudes of the baryon-baryon scatterings are derived in the SU_6 symmetry incorporating the spin and unitary-spin independence. Within each partial wave, all the baryon-baryon scatterings are related to the nucleon-nucleon scattering. (auth)

35084 EQUIVALENCE OF THE FREDHOLM AND MULTICHANNEL N/D METHODS IN POTENTIAL SCATTERING. Bali, N.; Munczek, H.; Pignotti, A. (Universidad, Buenos Aires). Nuovo Cimento (10), 38: 374-84 (July 1, 1965).

The nonrelativistic scattering by a Yukawa-like potential connecting a finite number of two-body channels without spin is considered. A formulation of the N/D method leading to Bjorken's prescription is presented, and it is shown that the determinant of the denominator is equal to the Fredholm determinant of the Lippmann-Schwinger equation. This leads to the conclusion that the vanishing of det D at negative energies is a necessary and sufficient condition for the existence of bound-state poles. (auth)

35085 NAKANISHI REPRESENTATION AND UNITARITY CONDITION. Chow, Y. (Univ. of Wisconsin, Milwaukee). Nuovo Cimento (10), 38: 395-9(July 1, 1965).

The explicit forms of the kernels appearing in the elastic unitarity condition are derived for the Nakanishi representation of scattering amplitude. (auth)

35086 S-MATRIX ELEMENTS IN THE TWO-PARTICLE UNITARITY APPROXIMATION FOR A WORLD OF ONE SPACE DIMENSION. Delbourgo, R. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cimento (10), 38: 410-21(July 1, 1965).

For a world having a single spatial dimension, the unitarity equations in the two-particle approximation are applied to deduce the cross-symmetric scattering amplitude and thereby determine the form factor and propagator of the theory; comparison of the full amplitude with the Born approximation reveals their quite different asymptotic characters. The solution is also used to discuss the problem of overlapping final-state interactions and it is proved that the enhancement is multiplicative in form. (auth)

35087 AN UPPER BOUND ON THE NEUTRON-DEUTERON ^2S SCATTERING LENGTH BY AN S-MATRIX METHOD. Segre, G. (CERN, Geneva). Nuovo Cimento (10), 38: 422-7(July 1, 1965).

An upper bound of 3.2×10^{-13} cm is obtained for the ^2S neutron-deuteron scattering length without any detailed knowledge of the nuclear potentials. Certain simple assumptions are made concerning the structure of the S-matrix, and the binding energies of the deuteron and the triton is what is required to obtain the bound. (auth)

35088 BROKEN SYMMETRIES AND MASS FORMULAE FOR VECTOR MESONS. Segre, G.; Sucher, J. (CERN, Geneva). Nuovo Cimento (10), 38: 428-37(July 1, 1965).

The question of which kind of mass formulas [$(\mathrm{mass})^2$ vs. $(\mathrm{mass})^{-2}$] are correct for a multiplet of vector mesons is studied. It is shown that from a field-theoretic point of view, one does not have a clear a priori preference for either kind of formulas. (auth)

35089 SINGULARITIES IN THE PHYSICAL REGION. Coleman, S. (Harvard Univ., Cambridge, Mass.); Norton, R. E. Nuovo Cimento (10), 38: 438-42(July 1, 1965).

It is shown that a Feynman amplitude has singularities on the physical boundary if and only if the relevant Feynman diagram can be interpreted as a picture of an energy- and momentum-conserving process occurring in space-time, with all internal particles real, on the mass shell, and moving forward in time. As a by-product of the proof, the Feynman parameter associated with an internal line is identified (within a proportionality factor) with the time the particle exists between collisions, divided by its mass. (auth)

35090 ON SINGULAR POTENTIAL SCATTERING. [PART] I. Del Giudice, E.; Galzenati, E. (Universita, Naples and Istituto Nazionale di Fisica Nucleare, Naples). Nuovo Cimento (10), 38: 443-58(July 1, 1965).

Asymptotic expansions of tg δ, valid either in weak-coupling or in the low-energy limit, are derived for scattering by inverse-power singular potentials in S-wave. The method is founded on the well-known possibility of determining the Jost functions by connecting at any point $r \neq 0$ the regular solution of the Schrödinger equation with a linear combination of the Jost solutions. A discussion of the results and an analysis of the method makes clearer some general features of the scattering by singular potentials and some significant aspects of the mathematics involved. (auth)

35091 $J = \frac{1}{2}$, $T = \frac{1}{2}$, $\pi\Lambda$ PHASE-SHIFTS IN MODIFIED KHURI REPRESENTATION ISOLATING VARIOUS CROSSED-CHANNEL POLES. Majumdar, R. (Univ. of Delhi). Nuovo Cimento (10), 38: 459-62(July 1, 1965).

A calculation of the $J = \frac{1}{2}$, $T = \frac{1}{2}$ $\pi\Lambda$ phase-shifts is made using the modified Khuri representation in which the various crossed-channel poles have been explicitly isolated and their effects studied. The change of sign in the phase-shift as observed experimentally seems to be due to the crossed-channel Λ^* exchange which provides maximum attractive force in the present case. (auth)

35092 A MODEL FOR THE CONNECTED PART OF THE THREE-BODY AMPLITUDE. Cushing, J. T. (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 38: 463-82(July 1, 1965).

After a review of the conflicting results of some of the previous work on the analytic properties of the various nonrelativistic three-body amplitudes as functions of total energy and total angular momentum, a model involving separable interactions is proposed and the amplitude describing the scattering of three free particles into three free particles is constructed rigorously and exactly. That analytic continuation to complex total angular momentum, j, through an orbital angular momentum is taken, which some mathematically incomplete investigations have used to conclude meromorphy in the total angular momentum. In fact, this continuation does not produce an amplitude meromorphic in j but one which does not have a dominating Regge-type singularity. As a result a Sommerfeld-Watson transformation cannot be used to provide information about the asymptotic behavior as a momentum transfer tends to infinity. On the basis of this and previous work on the same model for the bound-state parts of the three-body amplitude, the analytic properties of all the three-body amplitudes are summarized. The Regge mechanism of asymptotic dominance appears valid only for the elastic bound-state scattering amplitude and even here there is competition between a pole and a cut. (auth)

35093 DYNAMICAL MODELS AND THE POSSIBLE EXISTENCE OF A $\frac{3}{2}^+$ 27-PLET. Diu, B. (CERN, Geneva); Rubinstein, H. R. Nuovo Cimento (10), 38: 483-9(July 1, 1965).

The possibility that both a decuplet and a 27-plet of $\frac{3}{2}^+$ baryons exist is studied in the dynamical model generally used for such particles. In exact unitary symmetry, this possibility cannot be ruled out; however the 27-plet should, in this limit, lie somewhat higher than the decuplet. When symmetry breakdown is taken into account by neglecting high channels, the Λ^*, Y^*, Ξ^*, and Ω come out as they are expected to; on the other hand, difficulties appear with the members of the 27-plet, which could mean, if such dynamical arguments are correct and if this supermultiplet actually exists, that it is dynamically linked to other channels than just pseudoscalar mesons + $\frac{1}{2}^+$ baryons. (auth)

35094 PERATIZATION OF SOME HIGHER-ORDER DIAGRAMS. Miketinac, M.; Tadic, D. (Inst. Ruder Boskovic, Zagreb and Univ. of Zagreb). Nuovo Cimento (10), 38: 490-5(July 1, 1965).

The peratizational approach was applied to the Bethe-Salpeter equation including some higher-order irreducible diagrams. The most detailed and exact results are given for irreducible diagrams with the exchange of one boson line and of two crossed boson lines. (auth)

35095 JOINT DECAY DISTRIBUTION IN DOUBLE-RESONANCE PRODUCTION. Pilkuhn, H.; Svensson, B. E. Y. (CERN, Geneva). Nuovo Cimento (10), 38: 518-29(July 1, 1965)

The joint decay distribution for reactions like $K + p \rightarrow K^*\Lambda^*$ and $\bar{p}p \rightarrow \bar{\Lambda}^*\Lambda^*$ is derived in terms of the joint spin-space density matrix, using helicity formalism. The predictions of the peripheral model for these distributions are briefly discussed, and a general test of the peripheral model is given for the case of parity violation in one of the decays. (auth)

35096 APPLICATION OF THE HELICITY FORMALISM TO INELASTIC ELECTRON SCATTERING. Renard, F. M.; Tran Thanh Van, J.; Le Bellac, M. (Universite de Paris, Orsay, France). Nuovo Cimento (10), 38: 552-64 (July 1, 1965).

It is shown that the helicity formalism can be applied to inelastic electron scattering, in the case where there are two strongly interacting particles in the final state, and leads to simple cross section and polarization formulas. The particular case of the electrodisintegration of the deuteron is treated in detail. (auth)

35097 RELATIVISTIC THEORY OF THE ELECTRODISINTEGRATION OF THE DEUTERON. [PART] I. Renard, F. M.; Tran Thanh Van, J.; Le Bellac, M. (Universite de Paris, Orsay, France). Nuovo Cimento (10), 38: 565-96(July 1, 1965).

The electrodisintegration of the deuteron $e + d \rightarrow e + n + p$ is treated in a fully covariant manner. Theoretical aspects of the problem are examined in detail. The transition amplitude is written in terms of 18 Lorentz invariant forms, satisfying the requirement of gauge invariance. In a first application of this theory, only the nearest singularities are retained: those corresponding to the exchange of a nucleon and of a deuteron in the crossed and direct channels, respectively. The deuteron structure is included by using n-p-d vertex functions depending on the momentum transfer, while the final-state interaction is treated by using dispersions for the multipole amplitudes. The theory makes it possible to remove some of the ambiguities which appear in the usual semirelativistic calculations. (auth)

35098 BROKEN SYMMETRIES AND THE OVERHAUSER MODEL. Fano, G. (Universita, Bologna). Nuovo Cimento (10), 38: 597-607(July 1, 1965).

The mathematical structure of the Overhauser model is discussed, with particular attention to the question of the spontaneous breakdown of symmetry. A simple generalization to the case of an arbitrary compact symmetry group of Haag's procedure for re-establishing the broken symmetry is presented. Finally, it is proved that the model is exactly soluble in the limit of infinite volume, and representations of the canonical anticommutation relations suitable for the diagonalization of the Overhauser reduced Hamiltonian are briefly discussed. (auth)

35099 LOWER LIMIT FOR THE MASS OF THE INTERMEDIATE BOSON. Bernardini, G.; Bienlein, H.; Bohm, A. (and others). (CERN, Geneva). Nuovo Cimento (10), 38: 608-23(July 1, 1965).

The search for the muonic and the nonleptonic decays of the hypothetical intermediate boson among the neutrino events produced in the CERN neutrino experiment has been continued and concluded. The data do not give any clear evidence for such decays. Comparing the rate of possible boson reactions, observed in the spark chamber and the bubble chamber, with the calculated production rate, a lower limit for the boson mass is obtained, ranging from 1.7 to 2.2 Bev/c^2 for various assumptions about the relative abundance B of leptonic decays. (auth)

35100 MESON MASS RESONANCES. Sen, P. (National Physical Lab., New Delhi, India). Nuovo Cimento (10), 38: 624-6(July 1, 1965).

The possibility of an exact statement of the known meson resonances is shown by using the mass equations obtained from the metric field theory. Other resonances are also obtained which provide a stringent test for the validity of these mass equations. (J.F.P.)

35101 A NOTE ON NEUTRINO STATISTICS (IN CONNECTION WITH WATAGHIN'S PAPER). Kuchowicz, B. (Univ. of Warsaw). Nuovo Cimento (10), 38: 629-30 (July 1, 1965).

Examination of a recently published paper (Nuovo Cimento, 35: 1240(1965)) on the statistical equilibrium of neutrinos with electrons and photons revealed that considerations and results along the same lines were previously published (Bull. Acad. Polon. Sci. Ser. Sci.

Math., Astr. et Phys., 11: 317(1963)). However, the results of both papers considered are found to coincide. It is now further added that under certain conditions even massless neutrinos are proven to be able to move in a stationary way in superdense matter. (J.F.P.)

35102 KINEMATIC LIMITATIONS ON REGGE ASYMPTOTICS. Atkinson D. A.; Barger, V. (Univ. of Wisconsin, Madison). Nuovo Cimento (10), 38: 634-7 (July 1, 1965). (COO-30-100)

Attention is drawn to the kinematic limitation of the asymptotic Regge formalism which severely limits the domain of application of the Regge theory. The limitation is encountered for processes in which the s-channel, $1 + 1 \to 2 + 4$, is inelastic in the sense that at least one of the equalities $m_1 = m_2$ or $m_3 = m_4$ does not hold. (J.F.P.)

35103 CONSEQUENCES OF THE EXISTENCE OF MASSIVE MAGNETIC POLES. Carrigan, R. A. Jr. (Carnegie Inst. of Tech., Pittsburgh). Nuovo Cimento (10), 38: 638-41(July 1, 1965).

The theoretical and experimental evidence relating to the existence of magnetic monopoles is discussed in view of the recent observations of a possible CP violation. Also, a way is illustrated in which magnetic monopoles might play a useful role in elementary-particle structure. It is noted that in an attempt to observe such constituents of elementary particles, heavier ionizing particles rather than lighter ones should be sought. (J.F.P.)

35104 LAPLACE'S TRANSFORM AND SINGULAR POTENTIALS. Cornille, H. (CERN, Geneva); Burdet G.; Giffon, M. Nuovo Cimento (10), 38: 647-51(July 1, 1965).

The Jost solutions are investigated directly with the use of the inverse Laplace's transform. It is shown that if the ratio of the Jost solution to its singular part when $r \to 0$ is considered, one can still obtain the Jost function as the limit of convergent sequences. (J.F.P.)

35105 UNPHYSICAL UNITARITY OF PARTIAL-WAVE AMPLITUDES. Finkelstein, J. (Univ. of California, Berkeley). Nuovo Cimento (10), 38: 659-61(July 1, 1965).

The unphysical unitarity of partial-wave amplitudes is demonstrated from the unitarity relation for a partial-wave scattering amplitude. (J.F.P.)

35106 DECAY OF BARYON RESONANCES AND $\tilde{U}_{12}$ SYMMETRY. Konuma, M. (Scuola Normale Superiore, Pisa, Italy and Centro Ricerche Fisica e Matematica, Pisa, Italy); Remiddi, E. Nuovo Cimento (10), 38: 662-5(July 1, 1965).

The decays of baryon resonances N^* (1238), Y^* (1385), Ξ^* (1530), $B^* \to B + \pi$ are considered in the $\tilde{U}(12)$ model, the relativistic generalization of SU(6). (J.F.P).

35107 SOME REMARKS ON THE LEVINSON-TYPE THEOREMS IN A MODEL FIELD THEORY. Choudhury, S. Rai (Univ. of Delhi). Nuovo Cimento (10) 38: 666-8 (July 1, 1965).

The most successful attempt to prove for the relativistic case a Levinson-type theorem relating the phase shift at infinite energy to the number of bound states in that channel met contradictions in certain cases from the field-theoretical treatment recently carried out. An exactly solvable theory is now worked out to decide between these two versions. The model used has both a field theory and a dispersion theory. The results show agreement with the Levinson-type theorem. (J.F.P.)

35108 SCALAR VARIABLES FOR THE S-MATRIX. Rohrlich, F. (Syracuse Univ., N. Y.). Nuovo Cimento (10), 38: 673-4(July 1, 1965).

A generalization of the recently published generalization of the Mandelstam variables to an arbitrary number of particles is given. The restriction to particles of non-vanishing mass is lifted, and an expression for the degeneracy parameters is suggested. (J.F.P.)

35109 A NOTE ON A SPECIAL CLASS OF UNITARY REPRESENTATION OF THE INHOMOGENEOUS GROUP $\tilde{U}_{12} \times T_{143}$ WHICH UNDERLIES SALAM'S MODEL OF RELATIVISTIC SU_6 SYMMETRIES. Ruehl, W. (CERN, Geneva). Nuovo Cimento (10), 38: 675-9(July 1, 1965).

The group theoretical model permits the formal derivation of the field equations, which for physical momenta reduce to those which were assumed to hold in Salam's original version $\tilde{U}_{12}$ in an ad hoc manner. Also the logical structure of the $\tilde{U}_{12}$ model and the SL(6,C) model turn out to be equivalent. (J.F.P.)

35110 EXPERIMENTAL TEST OF CP INVARIANCE AND $\Delta S = \Delta Q$ SELECTION RULE. Baldo-Ceolin, M.; Calimani, E.; Ciampolillo, S.; Filippi-Filosofo, C.; Huzita, H.; Mattioli, F.; Miari, G. (Universita, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 38: 684-90(July 1, 1965).

The leptonic decays of neutral mesons (K) in the channels $e^{\pm}\pi^{\mp}\nu$ are studied in order to test CP invariance of the interaction responsible for such transitions and the $\Delta S = \Delta Q$ selection rule predictions for them. A heavy liquid bubble chamber was exposed to a 800 Mev/c mesons (K^+) beam. Mesons (K^0) were produced by mesons (K^+) charge exchange in the chamber. It is concluded that the hypothesis of CP invariance is ruled out with a confidence of 75%, and the hypothesis of validity of the $\Delta S = \Delta Q$ selection rule is disproved with a confidence larger than 95%. (J.F.P.)

35111 POSSIBLE PC VIOLATION AND POLARIZED TARGET. Desplanques, B.; Karpman, G. (Universite de Paris, Orsay, France). Nuovo Cimento (10), 38: 627-8 (July 1, 1965).

It is shown that if neutrinos were scattered on a polarized target, Cabibbo's assumption of CP violation in leptonic interactions (Phys. Lett., 12: 275(1964)), would give an important effect of asymmetry in observing the direction of the meson (μ) in the reaction $\nu_\mu + p \to n + \mu^+$, where p is a polarized proton. The calculated results are shown; but an experiment with a neutrino interacting with a polarized target is not possible at present. (J.F.P.)

35112 KINETIC EQUATIONS, QUASIPARTICLES AND RENORMALIZATION. Henin, F.; Prigogine, I.; Resibois, P.; Watabe, M. (Universite Libre, Brussels). Phys. Letters, 16: 253-4(June 1, 1965).

Reduction of the general kinetic master equation is reported. The reduction obtained is shown to be valid for a wide range of examples. This reduction is closely connected with the concept of quasiparticles as introduced by Landau for normal Fermi liquids and to renormalization in field theory. (M.O.W.)

35113 SLOW POSITRON PROCESSES IN GASES. Osmon, P. E. (London Univ.). Phys. Letters, 16: 271-2 (June 1, 1965).

It is pointed out that at present there is no overlap of experimental and theoretical studies of slow positron-atom collision processes. The annihilation rates in previous studies were measured. The possibility of calculating the annihilation rates is considered. (M.O.W.)

35114 SEARCH OF A PARITY VIOLATION IN THE NUCLEON-NUCLEON INTERACTION. Bock, P.; Schopper, H. (Technische Hochschule and Kernforschungszentrums, Karlsruhe, Ger.). Phys. Letters, 16: 284-5(June 1, 1965).

A check of previous calculations using a different experimental technique is presented. The method of Compton forward scattering from magnetized iron was used. A double magnet was used which had been utilized earlier in measuring the circular polarization correlation of the annihilation radiation. Experimental precautions taken are listed. (M.O.W.)

35115 A MEASUREMENT OF PROTON-PROTON BREMSSTRAHLUNG AT 160 Mev. Gottschalk, B.; Shlaer, W. J.; Wang, K. H. (Harvard Univ., Cambridge, Mass.). Phys. Letters, 16: 294-5(June 1, 1965).

Results of a preliminary investigation of proton-proton bremsstrahlung are reported. The kinematically allowed energies T_R and T_L for two protons emerging in the plane

of the beam at equal angles $\Theta = 30$, 35, and 40° are briefly described. A brief discussion of the cross sections is included. (M.O.W.)

35116 PHASE SHIFT ANALYSIS OF PROTON-PROTON SCATTERING AT 26 AND 51 Mev. Batty, C. J. (Rutherford High Energy Lab., Chilton, Berks, Eng.); Perring, J. K. Phys. Letters, 16: 301-4(June 1, 1965).

Phase-shift data are included for proton-proton scattering near 25 and 50 Mev. A comparison of this data with that reported previously is included. (M.O.W.)

35117 SOME REMARKS ON INTERNAL SYMMETRY AND LORENTZ INVARIANCE. Becchi, C. (Universita, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). Phys. Letters, 16: 317-18(June 1, 1965).

It is assumed that a Lie group G exists which contains both the Poincaré group and the internal symmetry group. The consequences of this hypothesis are considered. It is shown that a minimal invariant subgroup of G which contains the space-time translation group cannot be semi-simple. (M.O.W.)

35118 POSSIBLE CP-VIOLATION AND THE NATURE OF THE $\Delta = \frac{1}{2}$ RULE. Okun, L. B.; Zeldovic, B. Ya. (Academy of Sciences, Moscow). Phys. Letters, 16: 319-20(June 1, 1965).

The decay $K_2^0 \rightarrow 2\pi$ is interpreted as a consequence of CP violation. A model was proposed previously in which all CP violation is due to the additional factor i in the weak non-leptonic $\Delta Y = 1$ interaction lagrangian. This proposal is considered within the frame of the model of three fundamental hadronic fields. (M.O.W.)

35119 MESON-BARYON SCATTERING AND THE RELATIVIZED SU(6) SYMMETRY ($\tilde{U}(12)$). Marinov, M. S. (Academy of Sciences, Moscow). Phys. Letters, 16: 320-2 (June 1, 1965).

The processes $M + B \rightarrow M^1 + B^1$ where M, M^1 are the mesons from $35 \otimes \underline{1}$, and B, B^1 the baryons from $\underline{56}$ are considered. Only those reactions with the nucleon as the target and the charged meson as the projectile are considered. The amplitudes of 17 reactions are given. (M.O.W.)

35120 ELECTROPRODUCTION OF THE ISOBAR $N_{\frac{3}{2}}$ (1238) IN THE SU_6-SYMMETRY SCHEME. Geshkenbein, B. V. (Academy of Sciences, Moscow). Phys. Letters, 16: 323-4(June 1, 1965).

The reaction $e + p \rightarrow e + N_{\frac{3}{2}}$ (1238) is considered. Theoretical results are compared with experimental results by Hand (Phys. Rev., 129: 1834(1963)). A table of values of electromagnetic form factors of proton and neutron is included. This table indicates that SU(6) theory predicts correctly the value of the magnetic moment of transition. (M.O.W.)

35121 ORBITAL-LIKE REPRESENTATION OF SU(6). Krolikowski, W. (Inst. for Nuclear Research, Warsaw and Univ. of Warsaw). Phys. Letters, 16: 324-6(June 1, 1965).

The problem of extending the $SU(6)_s$ group in such a way as to include the angular momentum is considered. An infinite dimensional reducible representation of SU(6) is investigated, and by means of this representation 35 orbital-like generators of SU(6) are defined. Adding these operators to 35 spin-like generators of SU(6), some total angular momentum-like generators are derived, and in this way extend $SU(6)_s$ to a group which includes among its 35 generators the total angular momentum. (M.O.W.)

35122 QUARK MODEL FOR PARTICLE PRODUCTION AT EXTREMELY HIGH ENERGIES. Koba, Z. (Universitet, Copenhagen). Phys. Letters, 16: 326-8(June 1, 1965).

Two assumptions are made in an attempt to use a quark model for particle production at high energies. They are: (1) The (anti) baryon is composed of three (anti) quarks, coupled in a symmetric way. The meson is composed of a quark and an antiquark. (2) In the high energy collisions of hadrons, part of the kinetic energy of the incident particles is transformed into a number of quark-anti-quark pairs and these quarks and antiquarks will interact very strongly among themselves, reaching a kind of statistical equilibrium within a hot spot, and finally yield baryons, antibaryons, and mesons in proportion to the number of chances for their formation. (M.O.W.)

35123 THE CHARGE EXCHANGE $K^- + p \rightarrow \overline{K}^0 + n$ AT 9.50 Gev/c. Astbury, P.; Finocchiaro, G.; Michelini, A.; et al. (CERN, Geneva). Phys. Letters, 16: 328-31(June 1, 1965).

The total and differential cross sections for the reaction $K^- + p \rightarrow \overline{K}^0 + n$ are presented. Results are compared with theoretical models for the differential cross section. (M.O.W.)

35124 DEPENDENCE OF BOOTSTRAP CALCULATIONS ON THE CHOICE OF PARTIAL WAVE AMPLITUDE. Kapuscik, E.; Sewerynski, M.; Swiecki, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 16: 334 (June 1, 1965).

It was previously shown that in $\pi = N$ scattering the choice of the kinematic factor redefining partial wave amplitude influences bootstrap solutions. This dependence is considered taking the N_{33} resonance as an example. The results are compared with those obtained previously. (M.O.W.)

35125 THE $\omega \rightarrow \pi_0 + \gamma$ DECAY IN THE QUARK MODEL. Thirring, W. E. (Univ. of Vienna). Phys. Letters, 16: 335(June 1, 1965).

An equation representing the partial width of the decay $\omega = \pi_0 + \gamma$ is derived from relativistic consideration. This equation is compared with the standard expression representing the partial widths. (M.O.W.)

35126 SEARCH FOR HYPERON RESONANCES WITH SPARK CHAMBERS. Blackall, P.; Dowell, J. D.; Leontic, B.; Lewis, G. M.; Lundby, A.; Meyer-Berkhout, U. (CERN, Geneva). Phys. Letters, 16: 336-8(June 1, 1965).

Results are reported of a missing-mass experiment on hyperons γ^- of isotopic spin 1 or 2 produced in the reactions $\pi^- + p \rightarrow K^+ + \gamma^-$. The kinematic parameters of the K^+ mesons were determined with spark chambers, and the mass range covered was from 1 to 1.9 Bev/c. (M.O.W.)

35127 SHADOW UNIVERSE AND THE NEUTRINO EXPERIMENT. Okun, L. B.; Pomeranchuk, I. Ya. (Academy of Sciences, Moscow). Phys. Letters, 16: 338-40(June 1, 1965).

The hypothesis of shadow universe is shown to be in sharp disagreement with the results of the neutrino experiment. (G. Bernardini, Proc. of the Conf. on High Energy Physics, Dubna, 1964). (M.O.W.)

35128 NEUTRINO-INDUCED INTERACTIONS AND $\tilde{U}(12)$ SYMMETRY. Ketley, I. J. (Imperial Coll. of Science and Tech., London). Phys. Letters, 16: 340-2 (June 1, 1965).

The $\tilde{U}(12)$ theory developed previously by Salam et al., (Proc. Roy. Soc. A284, 146(1965)) is used to obtain form factors applicable to neutrino interactions, and in particular to the processes $\nu(\overline{\nu}) + N \rightarrow l^-(l^+) + N$ and $\nu(\overline{\nu}) + N \rightarrow l^-(l^+) + N^*$. Diagrams representing various cross sections are presented along with tables listing the high-energy behavior of these cross sections. (M.O.W.)

35129 FINAL STATE ENHANCEMENT AT 1920 Mev IN π^-p INELASTIC SCATTERING. Gutay, L. J. (Florida State Univ., Tallahassee); Lannutti, J. E.; Csonka, P. L.; Moravcsik, M. J.; Scadron, M. D. Phys. Letters, 16: 343-5(June 1, 1965). (UCRL-14100)

A discussion of the fact that the 1920 Mev final state enhancement in the reaction $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ when the incoming pion momentum is 2.16 Bev/c cannot be caused solely by a nucleon exchange process is presented. It is proposed that it is possibly the result of interference between ρ and $N^*(1238)$ production. (M.O.W.)

35130 ON THE RADIATIVE DECAYS OF VECTOR MESONS. Soloviev, L. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 16: 345-6(June 1, 1965).

The decays of vector mesons into a photon and a pseudoscalar meson in the SU(3) and SU(6) symmetry scheme are discussed. The connection between radiative decays and magnetic moments is considered. (M.O.W.)

35131 ON INCOMPATIBILITY OF THE RELATIVIZED SU(6) SYMMETRY WITH UNITARITY. Geshkenbein, B. V.; Ioffe, B. L.; Marinov, M. S.; Roginskii, V. I. (Academy of Sciences, USSR). Phys. Letters, 16: 347-8(June 1, 1965).

From previous studies of SU(6) symmetry, it was seen that the relations which are not consequences of invariance under some group generally contradict unitarity. This contradiction is discussed with the aid of simple examples. Quark-singlet-meson and quark-quark elastic scattering in the $\tilde{U}(12)$ scheme is considered. (M.O.W.)

35132 ON A MODEL OF ELEMENTARY PARTICLES SYMMETRY. Novozhilov, Yu. V. (Leningrad State Univ.). Phys. Letters, 16: 348-50(June 1, 1965).

The symmetry model built on the inhomogenous group $\tilde{P}(SU_6)$ with spatial reflections in it is discussed. This model is an attempt to describe all the phenomena with hadrons. Tests for the model are included. (M.O.W.)

35133 PRODUCTION AND DECAY OF K* (1400) IN 3.0 Gev/c K^-p INTERACTIONS. Focardi, S. (Istitute Nazionale di Fisica Nucleare, Bologna); Minguzzi-Ranzi, A.; Serra, P.; Monari, L.; Herrier, S.; Verglas, A. Phys. Letters, 16: 351-4(June 1, 1965).

The results of an analysis of the following reactions are presented: $K^- + p \to K^- + \pi^+ + n$, $K^- + p \to K^- + \pi^0 + p$, and $K^- + p \to \bar{K}^0 + \pi^- + p$. The ambiguities obtained during the analysis are pointed out, and various plots are given for the data obtained from the reactions. (M.O.W.)

35134 ASYMPTOTIC RELATIONS BETWEEN THE CROSS SECTIONS OF THE PION PRODUCTION IN NEUTRINO-NUCLEON INTERACTIONS. Hieu, Nguyen Van; Tu, Pham Qui (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 16: 357-9(June 1, 1965).

By applying a method used previously, the asymptotic equality of differential cross sections for the following processes is established; namely, $\nu + p \to l^- + \pi^+ + p$ and $\bar{\nu} + p \to l^+ + \pi^- + p$ where $l = \mu$ or e. (M.O.W.)

35135 SU_6, CURRENT-CURRENT INTERACTION AND PARITY-VIOLATING HYPERON DECAYS. Alles, W. (CERN, Geneva). Phys. Letters, 16: 359-60(June 1, 1965).

Recently, several partially successful results were obtained on non-leptonic decays assigning definite transformation properties under SU_6 to the effective non-leptonic weak interaction. Assuming a current-current interaction, PC invariance, and an interaction transforming like a member of an octet which belongs to the representation 35 of SU_6, Altarelli et al., (Phys. Letters, 14: 70 (1965)) have obtained two relations for the S wave amplitudes. A discussion of one of these, $\Sigma_1^+ = 0$, shows it to be valid in the framework of SU_6 under the quite general assumption of a current-current interaction and the $\Delta T = \frac{1}{2}$ rule. (M.O.W.)

35136 ON THE CANONICAL DECOMPOSITION OF THE GENERALIZED BOGOLIUBOV TRANSFORMATION. Bose, A. K.; Navon, A. (Universite, Montreal). Phys. Letters, 17: 112-13(July 1, 1965). (In French)

A geometrical interpretation is given for the generalized Bogoliubov transformation as a generalized rotation, and the feasibility is shown of introducing this in a simple way in its decay, by considering a certain type of plane rotations. It is concluded that outside the possibility of interpreting the generalized Bogoliubov transformation as rotations, the method shown allows a better systematization of the transformations of quasi-particles used to date to describe neutron-proton correlations. It is also believed that possibly four-particle transformations can be studied. (J.F.P.)

35137 APPROXIMATE SYMMETRY AND THE ALGEBRA OF CURRENT COMPONENTS. Dashen, R. F.; Gell-Mann, M. (California Inst. of Tech., Pasadena). Phys. Letters, 17: 142-5(July 1, 1965).

The theoretical foundations of the approximate symmetries of hadrons are explained including the generalization of U6 symmetry and its application to moving hadrons. The magnetic moment of the proton is obtained in terms of its mean squared charge radius. (J.F.P.)

35138 APPLICATIONS OF THE ALGEBRA OF CURRENT COMPONENTS. Dashen, R. F.; Gell-Mann, M. (California Inst. of Tech., Pasadena). Phys. Letters, 17: 145-8(July 1, 1965).

Some applications of the algebra of current components and the related algebraic properties of the weak and electromagnetic currents are discussed. It is concluded that the predictions of approximate higher symmetry for the mesons and baryons considered can be obtained by using the positive parity algebra of $U(6) \times U(6)$ as a rough symmetry of the states at rest. (J.F.P.)

35139 EVIDENCE FOR A MESON RESONANCE WITH STRANGENESS +2. Ferro-Luzzi, M.; George, R.; Goldschmidt-Clermont, Y.; Henri, V. P.; Jongejans, B.; Leith, D. W. G.; Lynch, G. R.; Muller, F.; Perreau, J. M. (CERN, Geneva). Phys. Letters, 17: 155-9(July 1, 1965).

The strangeness +2 meson system, KK, is investigated in some detail. This system is found in reactions of the type $K^+p \to KKY$ (or KKY plus mesons (π), where Y is a strangeness -1 hyperon. Such reactions occur at a very low rate, even when well above their threshold. This study was performed by means of about 400,000 pictures taken in the 80 cm Saclay hydrogen bubble chamber exposed to separated K^+ beams at 3, 3.5, and 5 Bev/c. (J.F.P.)

35140 TIME REVERSAL INVARIANCE AND SU(6). Ryder, L. (Middle East Technical Univ., Ankara). Phys. Letters, 17: 163(July 1, 1965).

It is shown by writing out the SU(6) invariant interaction lagrangian explicitly that SU(6) is not in contradiction with time reversal invariance. This is obtained by combining one of the two interactions for pseudoscalar mesons (φ) with one of the two interactions for the vector mesons V_λ. (J.F.P.)

35141 QUARKS, ASTROPHYSICAL AND PHYSICO-CHEMICAL ASPECTS. Zeldovic, Ya. B.; Okun, L. B.; Pikelner, S. B. (Academy of Sciences, Moscow). Phys. Letters, 17: 164-6(July 1, 1965).

The possibilities of a search for quarks of integral or fractional charge on the surface of the earth by using astrophysical observations are discussed. To find quarks of fractional charge the optical spectra of atoms containing such quarks may be used. In laboratory conditions such quarks may be found in experiments of the Millikan type where the elementary charge of a microsample is measured. Quarks of integral charge can be produced in cosmic rays. There is no theoretical argument against the existence of stable quarks with masses many orders of magnitude heavier than the mass of nucleons and even of heavy nuclei. (J.F.P.)

35142 A SEARCH FOR HEAVY HYPERON RESONANCES PRODUCED BY 5.7 Gev/c ANTIPROTONS IN HYDROGEN. Boeck, R. K. (CERN, Geneva); Cooper, W. A.; French, B. R.; Kinson, J. B.; Levi-Setti, R.; Revel, D.; Tallini, B.; Zylberajchs. Phys. Letters, 17: 166-9 (July 1, 1965).

The results on the mass distributions of final state systems with $S = -1$, $B = +1$ and their charge conjugates are presented. The Saclay 80cm hydrogen bubble chamber was exposed to a separated beam of 5.7-Bev/c antiprotons; and a total of 300,000 pictures was scanned and analyzed for hyperon-producing interactions. Evidence is found for a hyperon resonance at 2097 ± 6 Mev decaying mainly via the neutral KN and KNπ channels. Two other peaks are seen at 1.94 Bev and at 2.30 Bev in the KNπ systems. (J.F.P.)

35143 EXPERIMENTAL RESULTS ON THE ANNIHILATION $\bar{p}p \to KK\pi$ AT REST; K* PRODUCTION. Armenteros, R. (CERN, Geneva); Edwards, D. N.; Jacobsen, T.; (and others). Phys. Letters, 17: 170-1(July 1, 1965).

The annihilation $\bar{p}p \to \bar{K}K\pi$ at rest was investigated by exposing the Saclay 81 cm hydrogen bubble chamber to

beams of slow antiprotons. The K* production was studied by fitting the population of the Dalitz plot by a density function. The assumption was made that the annihilation at rest goes essentially via S-states. The results demonstrate that the singlet state contributes about 35% to the total annihilation rate for the reaction studied. (J.F.P.)

35144 ALGEBRA OF CURRENTS AND SYMMETRY. Okubo, S. (Univ. of Rochester, N. Y.). Phys. Letters, 17: 172-4(July 1, 1965).

Recently, it was shown that one may derive certain SU(6) relations like the ratio of the proton and neutron magnetic moments by using commutation relations among currents of weak interactions without explicitly assuming the SU(6) invariance. The extension of these arguments to more general cases is described. (J.F.P.)

35145 THREE-BODY FORCES IN THE $N\pi\pi$ SYSTEM. Sawyer, R. F. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 139: B151-4(July 12, 1965). (MIT-2098-122)

The applicability of Faddeev's equations to three-body scattering in field-theoretic models is discussed for the particular case of the $J = 5/2$, $T = 5/2$ nucleon-pion-pion system. The question posed is whether there exists some dynamical mechanism which causes three-particle scattering to be dominated by multiple two-particle scattering processes. The answer to this question depends on the relative importance of the Faddeev kernel and an irreducible three-body kernel to an integral equation. The three-body kernel is defined from a sum of particular Feynman graphs and is analogous to a three-body interaction in potential theory. For the (5,5) $N\pi\pi$ state a three-body force is calculated from a plausible approximation to the simplest appropriately irreducible static-model graph. Using Lovelace's static-model approximations for the off-shell elastic πN amplitudes and neglecting pion-pion scattering leads to a soluble three-body problem. The effect of the three-body force on the position of a (5,5) resonance is calculated and found to be quite large. (auth)

35146 ANALYSIS OF THE PROTON-PROTON SCATTERING DATA NEAR 27 Mev. Signell, Peter (Michigan State Univ., East Lansing). Phys. Rev., 139: B315-18 (July 26, 1965). (TID-21884)

Phase-shift analyses were made of 33 proton-proton single-, double-, and triple-scattering data in the energy range 25–30 Mev. The resulting good definition of the phase shifts was marred somewhat by an undesirable sensitivity to the single datum R(39°). The phases were in moderate agreement with those of recent nucleon-nucleon models. (auth)

35147 DETERMINATION OF THE NUCLEON-NUCLEON ELASTIC SCATTERING MATRIX. II. PHASE-SHIFT ANALYSES OF EXPERIMENTS NEAR 95, 142, 210, AND 310 Mev. MacGregor, Malcolm H.; Arndt, Richard A. (Univ. of California, Livermore). Phys. Rev., 139: B362-79(July 26, 1965). (UCRL-7942(Rev.I))

Phase-shift analyses were carried out for (p,p) and (n,p) experiments at energies near 95, 142, 210, and 310 Mev. Analyses both of (p,p) data and of combined (p,p) plus (n,p) data were made at these energies. Attention was concentrated in all cases on the Stapp-type 1 solution, the objective being to obtain the best possible values for the phase shifts from the existing nucleon-nucleon data. Error matrices were calculated for all solutions, and determinations of the pion-nucleon coupling constant g^2 were carried out. It was found that reasonably consistent values for g^2 can be obtained if a suitable selection of the phenomenological phase shifts is made. The T = 1 phase shifts determined from (p,p) data only were found to be in good agreement with the T = 1 shifts obtained from combined (p,p) plus (n,p) data, thus verifying the gross features of the charge independence. The results of phase-shift analyses near 142 Mev were previously given. Since publication, some changes in the data have occurred, and some improvements in the method of phase-shift analysis have been made. Hence new phase-shift values at 142 Mev that supersede the previous values are included. (auth)

35148 DETERMINATION OF THE NUCLEON NUCLEON ELASTIC-SCATTERING MATRIX. III. PHASE-SHIFT ANALYSES OF EXPERIMENTS NEAR 25 AND 50 Mev. Noyes, H. Pierre (Stanford Univ., Calif.); Bailey, David S.; Arndt, Richard A.; MacGregor, Malcolm H. Phys. Rev. 139: B380-6(July 26, 1965). (UCRL-12398)

Phase-shift analyses were carried out for (p,p) and (n,p) experiments near 25 and 50 Mev. Analyses of both (p,p) data and of combined (p,p) plus (n,p) data were made at these energies. The solutions thus obtained extrapolate to the Stapp type 1 solution found at higher energies. Error matrices were calculated for all solutions. The T = 1 phase shifts from the (p,p) and combined (p,p) plus (n,p) analyses were in good agreement. It was not possible to obtain determinations of the pion-nucleon coupling constant g^2. (auth)

35149 MEASUREMENT OF PION BETA-DECAY BRANCHING RATIO. Bacastow, Robert B. (Univ. of California, Berkeley); Ghesquiere, Claude; Wiegand, Clyde E.; Larsen, Rudolf R. Phys. Rev., 139: B407-18(July 26, 1965).

The branching ratio for pion beta decay, $R = (\pi^+ \rightarrow \pi^0 + e^+ + \nu)/(\pi^+ \rightarrow \mu^+ + \nu)$, was measured. Arrays of lead sheets, scintillators, and spark chambers were used to measure the angular distribution of the γ rays in delayed coincidence with stopping pions. Thirty-eight events remained after subtraction of a background of eight, leading to a branching ratio of $(1.07 \pm 0.21) \times 10^{-8}$. This result is in good agreement with conserved vector-current theory and with the results of other experiments. (auth)

35150 VARIATIONAL PRINCIPLE IN S-MATRIX DYNAMICS. Ito, D. (Louisiana State Univ., Baton Rouge). Phys. Rev., 139: B419-20(July 26, 1965).

By extending previous results, it is shown that a variational principle similar to that of Lippmann and Schwinger also exists in the N/D formalism of multichannel S-matrix theory. (auth)

35151 BOOTSTRAP MODEL OF MESON AND BARYON SUPERMULTIPLETS. Capps, Richard H. (Northwestern Univ., Evanston, Ill.). Phys. Rev., 139: B421-7(July 26, 1965).

The SU(6)-symmetric bootstrap model of the baryon supermultiplet is discussed and extended. The relation between the static limit of the model and relativistic interactions is discussed. A hypothesis is made concerning the meson-meson-meson interactions. The V_8 (vector octet) exchange forces in the $V_8 + V_8$ states may lead to the bootstrapping of the X_0 meson in this model. The bootstrapping of the other mesons is discussed. It is postulated that the lightest odd-parity baryon isobars are produced by meson exchange forces in meson-baryon S states. The lightest odd-parity resonances predicted from this postulate are a spin-$\frac{1}{2}$ singlet and a spin-$\frac{3}{2}$ octet. These may be identified with the 1405-Mev Y_0^* and the D_8 baryon-meson resonance octet. Recent data concerning the various decay amplitudes of the $\frac{3}{2}^-$ resonances are compared with the predictions of SU(3) symmetry. (auth)

35152 PERIPHERAL PRODUCTION AND DECAY OF RESONANCES IN HIGH-ENERGY MESON-NUCLEON COLLISIONS. Jackson, J. D. (Univ. of Illinois, Urbana); Donohue, J. T.; Gottfried, K.; Keyser, R.; Svensson, B. E. Y. Phys. Rev., 139: B428-46(July 26, 1965).

Data on quasi-two-body reactions initiated by high-energy meson-nucleon collisions are analyzed from the viewpoint of the peripheral model. The basic interaction mechanism is assumed to be pseudoscalar and/or vector exchange, and absorptive effects arising from coupling between different channels are taken into account. Excellent agreement is found between the one-pion-exchange model and the production and decay data for the processes $\pi^+p \rightarrow \rho^+p$ for incident momenta from ~2 to 8 Bev/c. A unified analysis of the reactions $K^+p \rightarrow K^{*+}p$ at 3 Bev/c, and $K^+n \rightarrow K^0p$ at 2.3 Bev/c, is presented; a single pair of vector coupling constants is able to account for the various angular distributions of production. The theory predicts, and preliminary data confirm, appreciable momentum-transfer

dependence of the K^* spin-density matrix. Equally satisfactory fits to the data are found for $K^+p \to K^0N^{*2+}$ at 3 Bev/c, $K^-p \to \pi^-Y^*$ (1385) at 2.24 Bev/c, and $\pi^+n \to \omega p$ at 3.25 Bev/c. In the latter reaction the absorption model reproduces the large departure of the ω-decay correlations from those characteristic of ρ exchange in the absence of absorption. the model cannot explain why the differential cross section for $\pi^+p \to \pi^0N^*$ is considerably narrower than for $K^+p \to K^0N^*$. The theoretical momentum-transfer distributions and decay correlations for double resonance production ($\pi p \to \rho N^*$, $Kp \to K^*N^*$) are in general agreement with the data, as are the results on combined decay correlations of ρ and N^* in $\pi^+p \to \rho^0N^*$. But the calculated absolute cross sections are considerably larger than observed, probably because the model fails to include the requirements of unitarity, important when the couplings are large. The determination of vector-meson coupling constants is discussed. Because of fundamental difficulties associated with vector-meson exchange amplitudes at high energies, it is concluded that important refinements of the model are necessary if such coupling constants are to be inferred from the data. (auth)

35153 MASS RELATIONS OF SU_3 IN A SOLUBLE ω-ϕ MIXING MODEL. Pietschmann, Herbert V. R. (Univ. of Virginia, Charlottesville). Phys. Rev., 139: B446-53(July 26, 1965).

A soluble model of SU_3-invariant meson-vecton interactions is investigated. ω-ϕ mixing is introduced as a soluble, symmetry-breaking interaction. Small form-factor effects in this interaction are also treated. Mass renormalization is carried out to study higher order effects in the Gell-Mann-Okubo formula for mesons. Two new mass formulas for vectons and an equation relating vecton masses to meson masses is derived. Finally, relations between bare coupling constants are studied. The agreement with experiment is generally good. (auth)

35154 NEUTRON FORM FACTORS FROM INELASTIC ELECTRON-DEUTERON SCATTERING. Hughes, E. B.; Griffy, T. A.; Yearian, M. R.; Hofstadter, R. (Stanford Univ., Calif.). Phys. Rev., 139: B458-71(July 26, 1965).

The electromagnetic form factors of the neutron were measured in the q^2 range from 1.0 to 30.0 F^{-2}. It is found that for values of q^2 greater than about 6.0 F^{-2} the square of the neutron's charge form factor $(G_{En})^2$ is consistent with zero to within an error of the order of 5% in the existing theoretical cross section. For values of q^2 less than 6.0 F^{-2} it is concluded that meaningful values of the neutron form factors cannot be given until the necessary corrections to the theory are better understood. The results on the neutron form factors are combined with recent measurements of the proton form factors to provide experimental determinations of the isotopic nucleon form factors. It is found that the ω and φ mesons provide a good approximation to the observed isoscalar form factors but that it is difficult to understand the behavior of the isovector form factors in terms of the ρ meson alone. (auth)

35155 VALIDITY OF THE PHASE-SHIFT REPRESENTATIONS. Fujii, Y. (Stanford Univ., Calif.). Phys. Rev., 139: B472-5(July 26, 1965).

A previous discussion on the validity of the phase-shift representation is further developed. An example treated in a previous work based on a separable-potential model is given in an improved method to show that such a representation fails in more general cases than those considered recently by Bander, Coulter, and Shaw, based on a simplified N/D model. It is also shown that $\delta_1(s)$, the imaginary part of the elastic phase shift, is a boundary value of a function which connects the elastic S-matrix element in the physical sheet to that in other Riemann sheets. Consequently, $\delta_1(s)$ should be so chosen as to satisfy certain mathematical conditions as well as to fit experiments. The simplest example of such a function is given. (auth)

35156 WEAK-INTERACTION DECAYS OF η MESON. Singer, Paul (Technion-Israel Inst. of Tech., Haifa). Phys. Rev., 139: B483-6(July 26, 1965).

A general discussion of the possible weak leptonic and nonleptonic decays of η is presented, with estimates for the rates. The leptonic modes $\eta \to \pi e(\mu)\nu$ exhibit the unique feature of involving only second-class currents. If these currents are as "strong" as the first-class ones, a value of $\sim 2 \times 10^{-9}$ is expected for the ratio of the rates of these decay modes to those of the main electromagnetic decays of η. The only interesting nonleptonic decay, $\eta \to 2\pi$, is a CP-violating process. (auth)

35157 LOW-ENERGY S-WAVE $\bar{K}N$ SCATTERING IN THE STATE T = 0. Kumar, Aditya (Univ. of Delhi). Phys. Rev., 139: B486-90(July 26, 1965).

An investigation of low-energy s-wave $\bar{K}N$ scattering in the state T = 0 was made in a two-channel matrix N/D formulation. The channels considered are $\bar{K}N$ and $\Sigma\pi$. The amplitudes are calculated in the Zachariasen-Zemach approximation. Contributions to the amplitudes from all the vector-meson, the baryon, and the $p_{\frac{1}{2}}$ baryon-resonance exchanges are included. The coupling constants are determined from unitary symmetry. The requirement that Re (det D) should be zero at the position of the 1405-Mev Y_0^* is imposed. The values of the s-wave $\bar{K}N$ complex scattering length, the energy dependence of the real and imaginary parts of q cot δ, and the T = 0, absorption cross sections in the low-energy region are calculated. The results are in good agreement with experimental data. (auth)

35158 ERROR AND CONVERGENCE BOUNDS FOR THE BORN EXPANSION. Manning, Irwin (Naval Research Laboratory, Washington, D. C.). Phys. Rev., 139: B495-500(July 26, 1965).

For scattering in nonrelativistic quantum mechanics, the range of validity of the perturbation expansion is studied by viewing the expansion as being generated by an iteration procedure, and applying to it a fundamental theorem for iteration processes. The theorem provides a sufficient condition for convergence and, at the same time, gives upper bounds on the error generated in truncating the expansion at a given number of terms. These error bounds for the wave function are in turn used to find upper bounds on the truncation error for the S-matrix expansion. Bounds for the exact S matrix are also given. These results are illustrated by applying them to the simple case of one-particle potential scattering, for both the plane-wave and partial-wave analyses. (auth)

35159 PERMUTATION SYMMETRY OF MANY-PARTICLE WAVE FUNCTIONS. Girardeau, M. D. (Univ. of Oregon, Eugene). Phys. Rev., 139: B500--(July 26, 1965).

The symmetrization postulate (SP) states that wave functions are either completely symmetric or completely antisymmetric under permutations of identical particles. It is shown by one-dimensional counter-examples that SP is not demanded by the usual physical interpretation of the mathematical formalism of wave mechanics unless one makes use of further physical properties of real systems; the error in a standard proof of SP which ignores these properties is pointed out. It is then proved that SP is true for those systems of spinless particles which have the following properties: (a) probability densities are permutation-invariant, (b) allowable wave functions are continuous with continuous gradient, (c) the 3n-dimensional configuration space is connected, (d) the hamiltonian is symmetric, and (e) the nodes of allowed wave functions have certain properties. The counterexamples show that SP is not a necessary property of those systems which do not have property (c). The proof is extended to particles with internal degrees of freedom (including spin) by noting that any observable commutes with every permutation and making use of a particular observable acting only on internal variables. Extraneous mathematical assumptions, such as that of the existence of a "complete" set of commuting observables, criticized by Messiah and Greenberg, are not employed. Some comments are made on the conventional nature of the concept of identity for similar particles; the equivalence between the usual

formulation in which different species of similar particles are treated as distinct, and that in which they are regarded as identical particles in different internal states, is emphasized. (auth)

35160 NONEXISTENCE OF PARITY EXPERIMENTS IN MULTIPARTICLE REACTIONS. Csonka, Paul L.; Moravcsik, Michael J.; Scadron, Michael D. (Univ. of California, Livermore). Phys. Rev. Letters, 14: 861-2 (May 24, 1965). (UCRL-14130-T)

Multiparticle reactions are demonstrated to be an easier way to determine parities. It is shown further that there are essentially no parity experiments involving more than four particles. It is proven that in a reaction involving more than four particles, and in the absence of dynamical information, it is impossible to determine the parity of any of the particles unless all particles are coplanar in the reaction center-of-mass frame. (J.F.P.)

35161 SMALL-ANGLE ELASTIC PION-PROTON SCATTERING AT HIGH ENERGIES AND THE REAL PART OF THE SCATTERING AMPLITUDE. Foley, K. J.; Gilmore, R. S.; Jones, R. S.; Lindenbaum, S. J.; Love, W. A.; Ozaki, S.; Willen, E. H.; Yamada, R.; Yuan, L. C. L. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 14: 862-6(May 24, 1965). (BNL-9142)

Results of a measurement of high-energy $\pi^{\pm}$-p elastic scattering in the Coulomb interference region is reported. Conclusive evidence is found for a sizable real part of the scattering amplitude in the region of incident momentum 8 to 14 Bev/c for both π^--p and π^+-p scattering. The magnitudes of the real amplitudes range from 10 to 35% of the imaginary amplitude, and in each case the sign (negative) corresponds to repulsive force. (J.F.P.)

35162 BREAKING OF $U_L(12)$ SYMMETRY. Oehme, Reinhard (Univ. of Chicago). Phys. Rev. Letters, 14: 866-9(May 24, 1965).

In the spurion theory of broken $U_L(12)$ symmetry the formal, initial $U_L(12)$ invariance of an amplitude is not only broken by the imposition of Bargmann-Wigner equations, which define the asymptotic states of physical particles, but also by spurions. A more detailed discussion of these spurions is presented, and a report is made of certain consequences of the spurion theory for meson-baryon amplitudes. (J.F.P.)

35163 EVIDENCE FOR A NEW 2π RESONANCE AT 700 Mev. Feldman, M. (Univ. of Pennsylvania, Philadelphia); Frati, W.; Halpern, J.; Kanofsky, A.; Nussbaum, M.; Richert, S.; Yamin, P.; Choudry, A.; Devons, S.; Grunhaus, J. Phys. Rev. Letters, 14: 869-71(May 24, 1965).

A study of the production and decay modes of neutral bosons produced in the reaction $\pi^- + p \rightarrow n +$ neutral particles has revealed evidence for a neutral boson of mass about 700 Mev which decays into two mesons (π). The experiments were made using π beams of momenta up to several Bev/c, and the main evidence for this resonance was observed with π momentum of 1.520 Bev/c. (J.F.P.)

35164 MEASUREMENT OF THE RECOIL PROTON POLARIZATION IN ELASTIC π^-p SCATTERING AT T_π = 410 AND 492 Mev. Bareyre, P. (Centre d'Etudes Nucleaires, Saclay, France); Bricman, C.; Longo, M. J. (and others). Phys. Rev. Letters, 14: 878-80(May 24, 1965).

The results for the recoil proton polarization in negative pion-proton elastic scattering as measured with a carbon plate spark chamber are given. Also shown are the preliminary results of a calibration run made to verify the values adopted for the analyzing power of the chamber. (J.F.P.)

35165 PION-PROTON PHASE-SHIFT ANALYSIS AT T_π = 410 AND 492 Mev. Bareyre, P.; Bricman, C.; Villet, G. (Centre d'Etudes Nucleaires, Saclay, France). Phys. Rev. Letters, 14: 881-4(May 24, 1965).

A recent phase-shift analysis of the π^+p scattering at T_π = 410 and 492 Mev and the recoil proton polarization for π^--proton scattering results permit the achievement of a complete phase-shift analysis for the $I = 3/2$ and $I = 1/2$ isospin states. With those polarization measurements, the total cross sections, elastic differential cross sections, forward elastic cross sections, and total inelastic cross sections were used. The search program minimizes the total χ^2 of these quantities, for π^+p and π^-p data, using a gradient method. (J.F.P.)

35166 IMPLICATIONS OF THE SMUSHKEVICH PRINCIPLE FOR TRILINEAR COUPLINGS. Haymaker, Richard W. (Univ. of California, Berkeley). Phys. Rev. Letters, 15: 69(July 12, 1965).

It is shown that the basic Smushkevich equations alone do not imply SU(n) invariance for the trilinear coupling an (n^2-1)-dimensional multiplet to two identical n-dimensional multiplets when generalized to the case in which an (n^2-1) multiplet couples to two identical multiplets. (J.F.P.)

35167 EVIDENCE FOR CONSTRUCTIVE INTERFERENCE BETWEEN COHERENTLY REGENERATED AND CP-NONCONSERVING AMPLITUDES. Fitch, V. L.; Roth, R. F.; Russ, J. S.; Vernon, W. (Princeton Univ., N. J.). Phys. Rev. Letters, 15: 73-6(July 12, 1965).

Some preliminary results are reported from an experiment designed to measure the phase of the CP-nonconserving component in a long-lived neutral meson (K) beam. The results, although only a small fraction of the total data, were analyzed, and show clearly that there is constructive interference between coherently regenerated and CP-nonconserving amplitudes. (J.F.P.)

35168 QUANTIZED GRAVITATIONAL THEORY AND INTERNAL SYMMETRIES. Komar, Arthur (Yeshiva Univ., New York). Phys. Rev. Letters, 15: 76-8(July 12, 1965).

A report is made on some consequences for internal symmetries of elementary particles which are now indicated by a careful investigation of the program to construct a general relativistic quantum theory of gravitation. A brief outline is given of the reasoning leading to the consideration of a specific group for the internal symmetries. The fact that the group obtained is an infinite group rather than a Lie group is no longer regarded as a serious impediment, since the Lie groups are unable to yield a mass splitting. (J.F.P.)

35169 IS CHARGE-CONJUGATION INVARIANCE BADLY BROKEN. Glashow, Sheldon L.; Sommerfield, Charles M. (Univ. of California, Berkeley). Phys. Rev. Letters, 15: 78-80(July 12, 1965).

Several simple C-nonconserving interactions, any one of which could provide a mechanism for the decay $K_2^0 \rightarrow 2\pi$ are considered. In comparing experimental data relating to C-nonconserving mesonic decay rates with phase-space estimates, there is found considerable suppression for the C-conserving $\omega\pi\eta$ and $\phi\pi\eta$ coupling constants, but no meaningful limit on the strength of the C-nonconserving $\rho\eta\pi$ coupling constant. It is also shown that even if this coupling is strong, it would not produce a significant charge asymmetry in η decay. (J.F.P.)

35170 PHENOMENOLOGICAL ANALYSIS OF THE REACTION $K^- + p \rightarrow \Lambda + \pi + \pi$ AT REST. Barshay, S.; Rabin, M. (Rutgers State Univ., New Brunswick, N. J.). Phys. Rev. Letters, 15: 80-5(July 12, 1965).

The results are presented of a complete phenomenological analysis of the following reactions, induced by mesons (K^-) captured at rest in hydrogen, $K^- + p \rightarrow \Lambda + \pi^+ + \pi^-$, and $K^- + p \rightarrow \Lambda + \pi^0 + \pi^0$. (J.F.P.)

35171 NEW MEASUREMENT OF THE LAMBDA MAGNETIC MOMENT. Hill, D. A. (Massachusetts Inst. of Tech., Cambridge); Li, K. K.; Jenkins, E. W.; Kycia, T. F.; Ruderman, H. Phys. Rev. Letters, 15: 85-9(July 12, 1965). (BNL-9258).

The magnetic moment of the Λ is remeasured in order to provide a better experimental test of certain baryon models and symmetry schemes. Polarized Λ's pass through a strong longitudinal magnetic field and the angle

of precession of the Λ polarized vector is measured by observing the asymmetry in the Λ decay. (J.F.P.)

35172 SECOND-ORDER PHENOMENA IN THE ANNIHILATION RATES OF POSITRONS IN GASES. Abid, I.; Paul, D. A. L. (Univ. of Toronto). Proc. Phys. Soc. (London), 85: 1308-10(June 1965).

Departures from the known linear dependence of annihilation rates on gas pressures are described. The annihilation rate per unit pressure in argon is increased by the addition of methane, a thermalization effect which confirms the strong velocity dependence of annihilation for very slow positrons in argon. In nitric oxide the annihilation rate varies as $a_1p + a_{11}p^2$ where p is the pressure and a_1, a_{11} are constants. (auth)

35173 ANNIHILATION OF A BARYON-ANTIBARYON PAIR INTO MESON AND VIRTUAL GAMMA-QUANTA ($\bar{N} + N \rightarrow \pi + e^+ + e^-$, $Y + N \rightarrow K + e^+ + e^-$) AT HIGH ENERGIES. Rekalo, M. P. (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 10: 357-67(Apr. 1965). (In Ukrainian)

The annihilation of a baryon-antibaryon pair into a meson and a virtual photon at high energies is investigated in the region of angles of formation of finite particles where the asymptotic amplitudes are defined by fermion Regge poles. The expression for the scattering amplitude is reduced to a factorized form. Both possible values of the intrinsic part of the (KNY) system are discussed. (auth)

35174 DYNAMIC SYMMETRY OF STRONGLY INTERACTING PARTICLES. Berestetskii, V. B. Usp. Fiz. Nauk, 85: 394-444(Mar. 1965). (In Russian)

A review of the classification of elementary particles on the basis of symmetry is presented, with particular consideration of the broadening of the symmetry group. (D.C.W.)

35175 PI^0-MESONS PRODUCTION IN PI^--N INELASTIC INTERACTIONS AT 6.8 Gev/c. Wang, Tsu-shiang; Lo, Chuen-shun; Ma, Ya-de; Chin, Yong-hsien; Ho, An-shiang. Wu Li Hsueh Pao, 21: 714-19(Apr. 1965). (In Chinese)

Using the 24-liter propane chamber, photographs from meson (π^0) production in inelastic interactions of mesons (π^-), 6.8 Bev/c with nucleons are examined. About 2700 pairs of stereoscopic pictures were scanned, and 1275 events of π^--N inelastic interactions were found in an effective region 29.3 cm wide. In these events, 936 π^--p and 339 π^--n events and 240 and 89 electron-positron pairs were observed, respectively. After taking account of the efficiency of the bubble chamber for detection of gamma-photons, it is found that the mean number of mesons (π^0) produced per event is 1.00 ± 0.06 and that the mean transverse momentum of the gamma-photons is 173 Mev/c. In addition, the energy distribution of the gamma-photons is especially examined. Under the assumptions that the gamma-photons are entirely due to π^0 decays and that the energy spectrum of the mesons (π^0) is the same as that of the mesons (π^a), an energy distribution of gamma-photons can be deduced from the energy distribution of the secondary mesons (π^a) produced in π^--N interactions at the same incident energy; the gamma-photon energy distribution obtained in the present experiment is in agreement with this deduced distribution within experimental error. (auth)

35176 THREE-BODY LEPTONIC DECAYS OF THE K^+ MESON. Yuan, Tung-tse; Chen, Shih (Academia Sinica, Peking). Wu Li Hsueh Pao, 21: 779-86(Apr. 1965). (In Chinese)

The energy spectra of the meson (π^0) in $K^+_{\mu 3}$ and K^+_{e3} decays, and the energy spectrum and longitudinal polarization of the meson (μ^+) in $K^+_{\mu 3}$ decay were calculated by the dispersion relation method on the assumptions that the weak interaction is of a universal V-A form and that the strange vector current is not conserved. Consequently, one subtraction is made for each of the dispersion relation for the form factors f_0 and f_1. Only the contribution of $K^*(m_* = 888$ Mev) intermediate state is considered in the calculations. If the ρarameter defined in the paper is assumed to be equal to 2.1, the results agree with experiments within their limits of errors. Thus, better agreement with experiments could be achieved by abandoning the assumption of partially conserved strange vector current. (auth)

35177 MESON AND BARYON SPECTROSCOPY. Lichtenberg, D. B. Augmented; updated edition of the article in Volume 36 of Springer Tracts in Modern Physics Ergebnisse der exakten Naturwissenschaften. New York, Springer-Verlag, 1965. 159p.

A review on the classification and properties of baryons and mesons is presented. Experimental observations on these particles and their interpretation on the basis of conservation laws are emphasized. 300 references. (D.C.W.)

35178 GRAVITATSIONNOE POLE I ELEMENTARNYE CHASTITSY. (Gravitational Field and Elementary Particles). Stanyukovich, K. P. Moscow, Izdatel'stvo "Nauka," 1965. 313p.

A brief critical analysis is given on the general theory of relativity and variational formalism used in the theory. A certain development and generalization of the formalism was made assuming that the relation between Regge tensor and pulse-energy tensor may be achieved by means of a (tensor or pseudotensor) matrix instead of a constant. This concept is used in the analysis of the gravitational radiation considered as an emission from any arbitrary elementary particle produced by fluctuation of energy in space. Various aspects of gravitational field and gravitational radiation with a strict variational formalism are considered. An analysis is also made of the hypothetical and less formal aspects of the relation between the particle structure and gravitation. (R.V.J.)

35179 THE PROPERTIES OF NEUTRINOS. Feinberg, G. (Columbia Univ., New York). p.85-94 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The properties of neutrinos are summarized. There are two types of neutrinos differing only by a single quantum number called a muon number, which also distinguishes electrons from neutrinos. On theoretical grounds the neutrino mass is zero, and the ν_μ has a very small momentum. The spin of a neutrino is $\frac{1}{2}$. Each neutrino occurs in only one helicity state, and the antineutrino occurs in the opposite helicity state. Neutrinos undergo only weak interactions. Meson (μ)-electron symmetry and the strength of interactions are also discussed. (J.F.P.)

35180 CERN NEUTRINO EXPERIMENT — PRECIS. Perkins, D. H. (Wills Physical Lab., Bristol, Eng.). p.95-8 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The CERN neutrino set up consists of a bubble chamber and of spark chambers. A preliminary analysis indicates that the cross section for the elastic process and the distribution are consistent with predictions. There is no evidence against neutron conservation, for a neutral lepton current, neutrino flip, "strange" neutrinos, violation of $\Delta S = T\Delta Q$, or Coulomb production of the intermediate boson. An upper limit is set for the magnetic moment of ν_μ of 10^{-7} Bohr magneton. Spark chambers give a rate of elastic events and an angular distribution of the mesons (μ) similar to those of the bubble chamber analysis. The measurement of possible lepton pair events possibly resulting from the production of intermediate bosons sets a limit on the boson mass of M_w less than 1.3 Bev. (J.F.P.)

35181 HIGH-ENERGY PHYSICS. p.3-17 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Studies are reported of detection of several "new" elementary particles and resonances; interactions of elementary particles; theoretical high-energy physics; and instrumentation for analyzing accelerator beams and photographic detector data. (T.F.H.)

Field Theory and Quantum Mechanics

Refer also to abstracts 34859 and 35178.

35182 (AD-610070) ENERGY MOMENTUM CONSERVATION AND SOME OF ITS CONSEQUENCES FOR THE CLASSICAL PARTICLE. Physical Sciences Research Papers No. 68. Post, E. J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Dec. 1964. 28p. (AFCRL-64-954). $2.00(CFSTI).

Mechanical energy and momentum (e-m) has an equivalent counterpart in electromagnetic energy and momentum (e-m) and vice versa if conservation is assumed for the sum of these two fundamental manifestations of e-m. The classical particle concept is reconsidered in the spirit of Kwal's emphasis on an invariant relation between the e-m tensor and the e-m vector. The notion of a mass-carrying particle is specified by introducing a concept of physical rigidity which permits a straightforward definition of states of rest and motion of particles and their associated fields. It then follows that an optional electromagnetic interpretation of rest mass applies to every particle-like object which in a rest frame is surrounded by an electrostatic or a magnetostatic field (for example, (+) and (−) pion, neutron, and antineutron). The conclusion also holds for particles characterized by a combination of an electric monopole and a magnetic dipole (for example, positron and electron), provided some simple symmetry requirements are met. The electromagnetic option for a neutral particle without a magnetic moment but with a rest mass (for example, pion and K meson) is that of a (temporarily) trapped standing wave. (auth)

35183 (AD-613030) ON THE STATISTICAL THEORY OF ELECTROMAGNETIC WAVES IN A FLUCTUATING MEDIUM. [PART] II. MATHEMATICAL BASIS OF THE ANALOGIES TO QUANTUM FIELD THEORY. Furutsu, K. (National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.). Dec. 7, 1964. 48p. (NBS-MON-79)

Many analogies to quantum field theory are inherent in the statistical theory of waves. This is due to the fact that basic equations exist in the latter theory which correspond closely to the fundamental equations of the former theory—to the commutation relations and the Heisenberg equation of motion. A probability density function of waves is introduced which corresponds to the probability amplitude function in quantum mechanics. The boundary conditions at infinity for this probability density function are then found to be expressed in the same form as the vacuum boundary conditions in field theory. The theory of the statistical Green's functions and their relations to the expectation values of the physical variables is also extensively developed, using auxiliary external sources of the wave and of the fluctuating medium. It is found that there exists a one-to-one correspondence between the formalism of Green's functions presented here and that used in field theory. The above correspondence may be important for a further development of the statistical theory of waves, just as the advanced techniques of field theory have greatly influenced the development of thermodynamics (or statistical physics). (auth)

35184 (JINR-P-2105) O POSTROENII KVAZIPOTENTSIALA V NEKOTORYKH MODELYAKH KVANTOVOI TEORII POLYA. (On a Construction of Quasipotential in Some Models of Quantum Field Theory). Desimirov, G. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 12p. Dep.(mn).

The general structure of the quasipotential in models involing the interaction of two-component spinor fields was treated. Under certain restrictions the necessity of appearing the pole term in the coupling constant is cleared up. The conditions are found under which it does not contribute to the quasipotential. (auth)

35185 (JINR-P-2118) OB OSOBENNOSTI "FOKUSIROVKI" V P-PROSTRANSTVE POSTOYANNOI KRIVIZNY. (On a Peculiarity of "Focusing" in p-Space of Constant Curvature). Mir-Kasimov, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 12p. (In Russian) Dep.(mn).

It is shown that the peculiarity of "focusing" arising in the field theory in p-space of constant curvature can be removed if the S-matrix is constructed in accordance with the group of motions of this space. (auth)

35186 (JINR-P-2144) OB USLOVII MAKROPRICHINNOSTI V NELOKAL'NOI TEORII POLYA. (On Macrocausality Condition in the Nonlocal Field Theory). Leznov, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 6p. Dep.(mn).

It is shown that the conclusion of Stuekelberg and Wanders concerning an impossibility of combining macrocausality and unitary conditions in the nonlocal field theory is due to an unfortunate choice of the antihermitian part of the vertex diagram. The problem is discussed of whether the macrocausality criterion is valid in a certain class of nonlocal theories. (auth)

35187 (JINR-P-2151) RESHENIE ZADACHI KOSHI DLYA SKALYARNOI DVUMERNOI MODELI POLYA BORNA-INFEL'DA. (A Solution of the Cauchy Problem for the Scalar Two-Dimensional Model of Born-Infeld Field). Barbashov, B. M.; Chernikov, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 15p. Dep.(mn).

The Cauchy problem is solved for the linear equation of the scalar Born-Infeld field in the two-dimensional case. The solution is obtained in the parametrical form $t = t(\alpha,\beta)$ $x = x(\alpha,\beta)$ $\phi = z(\alpha,\beta)$. It is pointed out that it determines the extremum surface in the three-dimensional pseudoeuclidean space. The solution found is interpreted from the point of view of the three-component field: the time t and the coordinate x, along with the field function ϕ, are treated as the components of this field. The limiting transition to the linear field equation is considered. (auth)

35188 (JINR-P-2152) METRIKA PROSTRANSTVA-VREMENI I NELINEINYE POLYA. (Space-Time Metric and Non-Linear Fields). Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 9p. Dep.(mn).

It is shown that in the case of the nonlinear field the space-time metric depends on the field and on its derivatives. A model of the scalar field is considered. (auth)

35189 QUANTUM FIELD THEORY OF LEPTONS. Zingl, Harald F. K. (Universitat, Graz). Acta Phys. Austriaca, 19: 201-11(1965). (In German)

A theory was outlined in which the leptons are subject simultaneously to two differing forces. The vacuum polarization was expanded to random leptons. Experiments were carried out that can test the theory. (tr-auth)

35190 ON THE CONCEPT OF SPINORS IN THE GENERAL RELATIVITY THEORY. Raab, Werner (Universitat, Bonn). Acta Phys. Austriaca, 19: 222-8(1965). (In German)

A spinor calculus was derived to identify the concepts of coordinate systems and systems of coordinates in the general relativity theory. The derivation was a refinement of tensor calculus. (J.S.R.)

35191 RIGOROUS SOLUTION OF THE EINSTEIN FIELD EQUATION FOR AN ELECTROSTATIC CHARGE ARRANGEMENT OF FINITE SELF-ENERGY. Efinger, Helmut J. (Universitat, Vienna). Acta Phys. Austriaca, 19: 264-7(1965). (In German)

The vacuum solution given by Jeffery, Nordstrom, Reissner, and Weyl for a radial symmetrical electric field can be carried on continuously in the internal space of a charge cloud held together by gravitational force. The pattern of the electric field, the charge density, and the energy density, as well as the metrics, are discussed. (tr-auth)

35192 LOCAL QUANTUM THEORY AND QUANTUM FIELD THEORY. Wightman, A. S. (Princeton Univ., N. J.). Ann. Inst. Henri Poincare, Sect. A, 1: 403-20 (1964). (In French)

Local quantum theory studies the von Neumann algebras, R(O), generated by the observables which can be measured by using an apparatus located in a bounded open set, O, of space-time, assuming certain properties. Some basic theorems are reviewed and the relation between the R(O) and quantum field theory is discussed. The principal new result is a proof that in quantum field theory fields cannot be defined in each point. (auth)

35193 GENERALIZED TRANSFORMATION OF BOGOLIUBOV AND SOLUTIONS OF THE DIRAC EQUATION. Andriambololona, Raoelina; Sirugue-Collin, Madeleine; Sirugue, Michel (Faculte des Sciences, Marseille). Compt. Rend., 260: 4458-9(Apr. 26, 1965). (In French)

By envisaging in field theory a generalized Bogoliubov transformation, it was shown that it can always be put in a form dependent essentially on two parameters. The case where the quasi-particles defined by the transformation are free fermions is studied and the conditions that this property imposes on the parameters are determined. (tr-auth)

35194 VARIATIONAL BOUNDARY CONDITION IN TAMM-DANCOFF'S METHOD. Stojanov, D. Compt. Rend. Acad. Bulgare Sci., 15: 703-6(1962).

A new method is proposed for the approximate determination of the eigenvalues and eigenfunctions of the stationary Schrödinger equation in the presence of strong perturbations. The method is illustrated by an example using the unharmonic oscillator, and a comparison is made between the obtained first four eigenvalues, and those found with the use of an electronic computer. From that comparison the advantage of the proposed method over that of Tamm-Dancoff is shown. (L.B.S.)

35195 GENERALIZED APPROXIMATE EXPRESSIONS OF POTENTIAL BARRIER PENETRATION. Hristov, St. G. Izv. Fiz. Inst. s Aneb. Bulgar, Akad. Nauk, 11: 221-37 (1963).

An attempt is made to find the quasi-classical solution of Schrödinger's equation for arbitrary barriers which is to be valid for all values of the potential barrier from U = A to U = ∞, where A is the constant from Eckart's solution. In a previous work a formula was suggested for the penetration of barriers which is given a stricter substantiation. This formula is a generalization of the expression reached by the method of Wentzel-Brillouin-Kramers. By means of this generalization the transparency for arbitrary energies of the passing particles was calculated. With the help of the generalized quasi-classical formula it is possible to deduce the formula on the transparency of a rather general type of barriers which include the parabolic barrier and Eckart's barrier as particular cases. If Boltzmann's law on the distribution of the energy of the particles is valid, then the formula can be used for evaluating the tunnel effect for Eckart's generalized barrier. (auth)

35196 CONSERVATION LAWS FOR FREE FIELDS. Kibble, T. W. B. (Imperial Coll. of Science and Tech., London). J. Math. Phys. (N. Y.), 6: 1022-6(July 1965).

The recently discovered conservation laws for the "zilch" of the electromagnetic field (of which a simple derivation is presented) are examined in the context of a general discussion of bilinear conserved quantities in free-field theories. It is shown that there is always an infinite set of these quantities, and a method of finding them all is presented and illustrated by applications to simple theories. The existence of these conserved quantities is shown to be a consequence of the fact that the momentum-space density is constant in time. (auth)

35197 GEOMETRIZATION OF A MASSIVE SCALAR FIELD. Penney, R. (Ford Motor Co., Dearborn, Mich.). J. Math. Phys. (N. Y.), 6: 1029-31(July 1965).

A set of necessary and sufficient conditions involving only the metric tensor and the Einstein tensor $G_{\mu\nu}$ are given which thereby guarantee that $G_{\mu\nu}$ may represent the stress-energy tensor of a massive real scalar field. One of the conditions is nonlocal, and is a demand that the energy tensor vanish at spatial infinity. (auth)

35198 QUANTUM MECHANICAL TIME. Rankin, Bayard (Case Inst. of Tech., Cleveland). J. Math. Phys. (N. Y.), 6: 1057-71(July 1965).

Some suggestions on the probabilistic structure of quantization are first obtained by studying local properties of random variables such as continuity and differentiability with respect to a topology in the sample space. This analysis is extended to analytic functions on the complex plane and conditions are formulated under which probability densities are expressed as sums of absolute squares of complex numbers. Physical restrictions are introduced through the Schrödinger equation for a single bound-particle system. As a result, observations on a physical system become identified with the random selection of points in a topological measure space and the physical observables such as energy, position, and momentum, as well as time, are identified with measurable functions on appropriate spaces. Time, considered as a function, appears to be multiple-valued with spacings between multiple values and a detailed functional structure that characterizes and is characterized by the physical system under observation and the physical observables being measured. Its details functional structure is related to the physically measured probabilities of quantum theory and it is seen to serve in the capacity of a conditioning random variable in the computation of quantum mechanical expectations. (auth)

35199 ALGEBRAIC DIFFICULTIES OF PRESERVING DYNAMICAL RELATIONS WHEN FORMING QUANTUM-MECHANICAL OPERATORS. Arens, Richard; Babbitt, Donald (Univ. of California, Los Angeles). J. Math. Phys. (N. Y.), 6: 1071-5(July 1965).

Proofs are presented showing impossibility of assigning differential operators (quantum observables) to classical mechanical observables in such a way as to preserve the usual bracket formalism. Difficulty is shown to arise even if we limit ourselves to preserving brackets between the hamiltonian and a rather limited set of observables. Some other algebraic difficulties inherent in the operator assignment problem are also discussed. (auth)

35200 SCHRÖDINGER BASIS FOR SPINOR REPRESENTATIONS OF THE THREE-DIMENSIONAL ROTATION GROUP. Pandres, Dave, Jr. (Douglas Aircraft Co., Inc., Santa Monica, Calif.). J. Math. Phys. (N. Y.), 6: 1098-1102(July 1965).

It is shown that the double-valued spherical harmonics provide a basis for the irreducible spinor representations of the three-dimensional rotation group. Pauli's assertion to the contrary is shown to be false. Both infinitesimal and finite rotations are discussed in some detail. It is also shown that there remains a twofold degeneracy in the spherical harmonic Y_{jm} when j and m are specified. (auth)

35201 SUFFICIENT CONDITIONS FOR AN ATTRACTIVE POTENTIAL TO POSSESS BOUND STATES. [PART] II. Calogero, F. (Universita, Rome and Istituto Nazionale di Fisica Nucleare, Rome). J. Math. Phys. (N. Y.), 6: 1105-7(July 1965).

A condition sufficient to secure the existence of at least one bound state for each angular momentum $l \leq L$ is given by the inequality $-\int_0^\infty d(qr)V(r)/[(qr^{2L}q^2 - (qr)^{-2L}V(r)] > 1$, where q is an arbitrary constant and V(r) an everywhere-attractive potential. (auth)

35202 ON POLYNOMIAL SYSTEMS IN A BANACH RING. Taylor, J. G. (Cambridge Univ., Eng.). J. Math. Phys. (N. Y.), 6: 1148-51(July 1965).

Equations on Banach rings (algebras) which are of polynomial form are defined and discussed. A local uniqueness theorem for the homogeneous case, and an existence and local uniqueness theorem for the nonhomogeneous case are

proved. In order to apply these results to the equations of Lagrangian quantum field theory it is found necessary to extend the concept of the ring to that of an n-ring. The resulting theory is applied to a simple model equation arising in quantum field theory. (auth)

35203 PROOF AND REFINEMENTS OF AN INEQUALITY OF FEYNMAN. Symanzik, Kurt (New York Univ., New York). J. Math Phys. (N. Y.), 6: 1155-6 (July 1965).

A lower bound given by Feynman for the quantum mechanical free energy of an oscillator is proved, refined, and generalized. The method, application of a classical inequality to path integrals, also gives upper bounds for one-temperature Green's functions. (auth)

35204 SINGULARITIES OF ANALYTIC FUNCTIONS HAVING INTEGRAL REPRESENTATIONS, WITH A REMARK ABOUT THE ELASTIC UNITARITY INTEGRAL. Gilbert, R. P.; Howard, H. C.; Aks, S. (Univ. of Maryland, College Park). J. Math. Phys. (N. Y.), 6: 1157-62 (July 1965).

A survey is given of some results which have been obtained recently concerning the singularities of holomorphic functions having integral representations. These results are all essentially extensions or modifications of those developed by Hadamard (for the proof of his multiplication of singularities theorem) to the case of several complex variables. The connection between the original Hadamard idea and the elastic unitarity integral of the quantum theory of fields is considered. (auth)

35205 SOLUTION OF THE KLEIN-GORDON AND DIRAC EQUATIONS FOR A PARTICLE WITH A PLANE ELECTROMAGNETIC WAVE AND A PARALLEL MAGNETIC FIELD. Redmond, Peter J. (Defense Research Corp., Santa Barbara, Calif.). J. Math. Phys. (N. Y.), 6: 1163-9(July 1965).

Solutions of the Klein–Gordon and Dirac equations are obtained for a particle moving in an arbitrary plane electromagnetic wave in vacuo plus a uniform static magnetic field parallel to the direction of propagation of the electromagnetic wave. (auth)

35206 ON THE APPROXIMATION OF QUANTUM FIELD THEORIES. Jaffe, Arthur (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 6: 1172-8(July 1965).

It is assumed that the Wightman distributions are tempered and that they are boundary values of functions analytic in the forward tube. Under these conditions a sequence of such distributions may converge in Borchers' topology. The necessary and sufficient conditions for such convergence are spelled out in terms of the corresponding analytic functions. The two cases with and without the assumption of the spectral condition are separately treated. A discussion of other topologies and some examples of the use of this technique are given. (auth)

35207 VECTOR CLIFFORD ALGEBRAS AND THE CLASSICAL THEORY OF FIELDS. Teitler, S. (Naval Research Lab., Washington, D. C.). Nuovo Cimento (1), 3: Suppl., 1-14(1965).

The Clifford algebras are discussed based on unit elements in a vector space which is for the most part identified with Lorentz space-time. The discussions concern the scalar and pseudoscalar fields, the Proca field, and Spinor solutions to the Dirac-like equation. The vector Clifford algebra associated with the Lorentz metric over the real or complex field is used to compactly formulate a description of classical field theory. (J.F.P.)

35208 CONCERNING METRIC AND CONSTITUTIVE RELATIONS IN ELECTROMAGNETIC THEORY. Teitler, S. (Naval Research Lab., Washington, D. C.). Nuovo Cimento (1), 3: Suppl., 15-21(1965).

The Clifford formulation based on the space-time metric combines Maxwell's equations and the constitutive relations to yield the vacuum electromagnetic equations. This discussion is also generalized to nonvacuous media. (J.F.P.)

35209 SOURCE OF THE SCHWARZSCHILD FIELD. Tangherlini, F. R. (Duke Univ., Durham, N. C.). Nuovo Cimento (10), 38:153-74(July 1, 1965).

An analysis is given of the fundamental question raised by Wheeler as to whether the Schwarzschild field, in the absence of a finite interior solution, may be regarded as describing an everywhere empty space-time manifold. A model is constructed with a finite source tensor (the island model), and it is shown that one obtains a delta-function point mass source tensor for the Schwarzschild field as a limiting case. It is also shown using Einstein's pseudotensor that there is a contribution to the total energy of the Schwarzschild field that is not due to gravitational energy. In the course of the analysis, a subtraction formalism for handling gravitational energy divergences in polar co-ordinates is also developed. It is concluded that a source-free interpretation of the Schwarzschild field is not possible. A critique of the point mass is also given, and also an interpretation of the divergences as gauge-jumps. (auth)

35210 HAMILTONIAN THEORY OF GRAVITATION. Ahmad Hashmy, S. M. (Univ. of Allahabad, India); Mishra, R. S. Nuovo Cimento (10), 38: 234-9(July 1, 1965).

In Dirac's approach towards the hamiltonian formulation of the theory of gravitation, there has crept an error in the computation of momenta, canonically conjugate to the fundamental metric as the field variables, which reduces the actual momenta from what they ought to be by a factor ½. Consequently, this has caused errors in the computation of the hamiltonian. An attempt is made to correct those errors. (auth)

35211 GAUGE TRANSFORMATIONS IN STOCHASTIC QUANTUM ELECTRODYNAMICS. Canfield, J. M. (Univ. of Oklahoma, Norman). Nuovo Cimento (10), 38: 240-5 (July 1, 1965).

Invariance of the S-matrix of ordinary quantum electrodynamics under gauge transformations of the electromagnetic field is demonstrated explicitly. The behavior of the S-matrix of stochastic quantum electrodynamics is examined under gauge transformations of the mean value electromagnetic field $A_\mu(x;\mathcal{F})$. This stochastic S-matrix is not strictly gauge invariant, to the same degree that the theory fails to satisfy microcausality. (auth)

35212 UNCERTAINTY RELATION WITH ANGLE VARIABLES. Evett, A. A.; Mahmoud, H. M. (Univ. of Arizona, Tucson). Nuovo Cimento (10), 38: 295-301 (July 1, 1965).

An extension of the recent work of Judge on establishing a correct uncertainty relation between orbital angular momentum and the corresponding angle variable is presented. The equation for the minimum uncertainty states is derived and is applied to the problem of obtaining optimum parameters in the uncertainty relation. (auth)

35213 ON THE SO-CALLED PARADOX OF EINSTEIN, PODOLSKY AND ROSEN. Breitenberger, E. (Ohio Univ., Athens). Nuovo Cimento (10), 38: 356-60(July 1, 1965).

It is shown that the well-known experiment discussed by Einstein, Podolsky, and Rosen (1935) does not furnish a prediction or a measurement, as has always been held, but only an inference. The later discussions by Bohm and others are shown to contain unverifiable and therefore inadmissible statements involving several components of the same angular momentum vector. In either case there is no paradox. (auth)

35214 TRACES OF PRODUCTS OF SPHERICAL COMPONENTS OF ANGULAR MOMENTUM OPERATORS. Bose, A. K. (Univ. of Montreal). Nuovo Cimento (10), 38: 385-94(July 1, 1965).

A method for the generation of distinct products (with nonvanishing traces) of spherical components of angular momentum operators and the evaluation of their traces is presented. As illustrations all possible distinct prototypes of products with up to 4 pairs of raising and lowering operators are constructed and a table with the help of

which the traces of these products can be evaluated is given. As examples the traces of a few products of degree 11-15 are evaluated. Relations between traces of certain distinct products are derived and the problem of the construction of tables of traces of degree ≤9 is analysed. (auth)

35215 THE LORENTZ CONDITION IN QUANTUM THEORY. Just, K. (Argonne National Lab., Ill. and Univ. of Arizona, Tucson). Nuovo Cimento (10), 38: 400-9(July 1, 1965).

The reasons against adopting the Lorentz condition as an operator equation are not serious enough to justify the usual devices for avoiding this. Therefore, electrodynamics has its best foundation in the Landau gauge, in which also the photon propagator is simplest. (auth)

35216 A NOTE ON THE CINI-TOUSCHEK TRANSFORMATION. McClure, J. A.; Weaver, D. L. (Tufts Univ., Medford, Mass.) Nuovo Cimento (10), 38: 530-5 (July 1, 1965).

A discussion of the Cini-Touschek transformation is given for spin one-half which exhibits the extreme relativistic nature of the transformation. A unitary generalization of this transformation valid for arbitrary spin is given. This is discussed in detail for spin one and is shown to be related to the extreme relativistic limit of the Jordan-Mukunda spin-one theory. Advantages and disadvantages of this generalization are discussed. (auth)

35217 RENORMALIZATION EFFECTS WITH SINGULAR POTENTIALS. Ahmed, M. A.; Fairlie, D. B. (Univ. of Durham, Eng.). Nuovo Cimento (10), 38: 547-51(July 1, 1965).

The iterative solution of the Schrödinger intergral equation (for zero energy) associated with certain singular potentials containing logarithmic singularities of the form $\log^n r/r^2$ fails to converge unless a cut-off is introduced. The solution for these potentials is shown to be renormalizable by a multiplicative factor dependent upon the cut-off. The existence of a perturbation-series solution with divergent terms as an indication that the closed solution possesses an essential singularity in the expansion parameter is examined for a soluble case, and a functional relationship between this parameter and the cut-off is found which explicitly exhibits the essential singularity in the perturbation series. This phenomenon is conjectured to occur in a more general situation. (auth)

35218 EMBEDDING OF THE SCHWARZSCHILD AND REISSNER-WEYL SOLUTIONS. Rosen, J. (Tel-Aviv Univ., Israel). Nuovo Cimento (10), 38: 631-3(July 1, 1965).

The exterior Schwarzschild solution in conformal space, the Reissner-Weyl (charged particle) solution, and the interior Schwarzschild solution were embedded in (++ – – – –). The first two are now embedded in (+ – – – – –) and the last in 5-dimensional (+ – – – –). (J.F.P.)

35219 THE FEYNMAN DIAGRAMMATIC TECHNIQUE FOR THE DOUBLE TIME DEPENDENT CAUSAL GREEN'S FUNCTION. Chang, Shih-chun (Academia Sinica, Peking). Wu Li Hsueh Pao, 21: 858-65(Apr. 1965). (In Chinese)

Starting from a discussion of analytic properties and using the Landau relation to improve the diagram technique of Dzyaloshinskii, the Feynman diagram technique for the double time dependent causal Green's function is established. (auth)

35220 REMARK ON THE MISUSE OF THE ACTIVE INTERPRETATION OF GENERAL RELATIVITY. Englert, F.; Brout, R. (Universite Libre, Brussels). Phys. Letters, 16: 250-1(June 1, 1965).

The term ma in Newton's equation was interpreted previously as an induced force on a particle due to the acceleration of all the distant stars with respect to this particle. The incorrectness of this type of argument is pointed out. (M.O.W.)

35221 DOUBLE TIME TEMPERATURE DEPENDENT GREEN FUNCTIONS FOR GENERALIZED ENSEMBLES. Enoch, J.; Johnston, E. A. (Univ. of Kansas, Lawrence). Phys. Letters, 16: 265-6(June 1, 1965).

It was previously pointed out that in the case of the grand canonical ensemble certain difficulties arise in interpreting the poles of the single particle Green function as the excitation energies of the system. An extension of the formalism in which H′ is any operator such that $[H',H]_- = 0$ is presented. (M.O.W.)

35222 DOUBLE PERTURBATION THEORY AND WEIGHTING OPERATORS. Chen, J. C. Y. (Brookhaven National Lab., Upton, N. Y.). Phys. Letters, 16: 269-70 (June 1, 1965). (BNL-9094)

It is shown that approximate wavefunctions, made stable with respect to a set of chosen weighting operators, are accurate for the calculation of expectation values of operators other than the energy, to the first order in double perturbation theory. (M.O.W.)

35223 ON HIGHER SYMMETRIES IN QUANTUM MECHANICS. Fris, J.; Mandrosov, V.; Smorodinskii, Ya. A.; Uhlir, M.; Winternitz, P. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 16: 354-6(June 1, 1965).

A search to find all potentials in non-relativistic quantum and classical mechanics which demonstrate a higher symmetry (not purely of geometrical origin) is included. Operators, which satisfy the equation $[H,L_i] = 0$ where $H = -\frac{1}{2}\Delta + V(x_1,x_2)$, are found and used to construct a Lie algebra. (M.O.W.)

35224 GAUGE INDEPENDENCE AND PATH INDEPENDENCE. Rohrlich, F. (Syracuse Univ., N. Y.); Strocchi, F. Phys. Rev., 139: B476-82(July 26, 1965).

Quantum electrodynamics is formulated in a gauge-independent as well as path-independent way. The theory is manifestly Lorentz covariant. It can be obtained from the path-dependent electrodynamics of Mandelstam by an averaging process. The commutation relations and propagators in this gauge-independent formulation correspond to those of the Landau gauge in the conventional theory, giving this gauge a fundamental significance. The method is also applied to the gauge-invariant theory of neutral vector mesons with nonvanishing mass interacting with a conserved current. The resulting theory is gauge-independent and describes a pure spin-1 particle, the spin-0 contributions being identically zero. (auth)

35225 NEW TESTS FOR THE INVARIANCE OF THE VACUUM STATE UNDER THE LORENTZ GROUP. Phillips, Peter R. (Washington Univ., St. Louis, Mo.). Phys. Rev., 139: B491-4(July 26, 1965).

It is assumed that Lorentz invariance is broken in the simplest possible way by the existence of a constant vector field λ^μ which is coupled as if it were an ordinary quantized field. The presence of λ^μ could explain the decay of K_2^0 into $\pi^+\pi^-$ and avoid the difficulties which accompany a similar theory put forward by Bell and Perring. If the coupling is through axial- as well as polar-vector terms a new set of low-energy experiments will serve to elucidate the form of λ^μ in much greater detail than is possible by using K_2^0. Present experimental limits are discussed and it is concluded that their improvement by several orders of magnitude is feasible. (auth)

35226 JWKB APPROXIMATION. CONTRIBUTIONS TO THE THEORY. Froeman, Nanny; Froeman, Per Olof. Amsterdam, North-Holland Publishing Company, 1965. 144p. $4.50.

A formal derivation of the JWKB approximation is presented. The exact solution of the one-dimensional time-independent Schroedinger equation is obtained in a form which makes it possible to study effectively the properties of the JWKB approximation. Barrier transmission, bound states, and the radial equation of motion for a particle in a central field of force are treated. (C.E.S.)

Geophysics

Refer also to abstracts 34833, 34850, 34858, 35515, and 35517.

35227 (AD-609844) IONOSPHERIC PROCESSES AND NITRIC OXIDE. Scientific Report No. 228. Nicolet, Marcel (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Dec. 20, 1964. Contract AF19(628)-4014. 33p. (AFCRL-64-948). $2.00(CFSTI).

Analysis of ionic processes in the ionosphere leads to the conclusion that nitric oxide and its ion are produced by a reaction between nitrogen molecules and molecular oxygen ions. Such a process implies a substantial increase of nitric oxide in the E layer to a value greater than the photochemical concentration. In the lower D region, N_2^+ and O_2^+ ions produced by cosmic rays are transformed into NO^+ ions. A quantitative estimate shows that these conclusions are consistent with observational data in the chemosphere and ionosphere and also suggests the explanation of the night airglow continuum, (auth)

35228 (AD-611326) VARIATIONS IN ENERGY SPECTRUM OF AURORAL ELECTRONS DETECTED BY SIMULTANEOUS OBSERVATION WITH PHOTOMETER AND RIOMETER. Scientific Report No. 8. Johansen, O. E. (Norsk Institutt for Kosmisk Fysikk, Oslo). [1964]. Contract AF(052)-680. 25p. (AFCRL-65-59) $1.00(CFSTI).

Limited to cases with homogeneous auroral forms covering most of the sky, observations at 5577 Å and 27.6 MHz show that the energy spectrum can remain constant for long periods, from half an hour to several hours and whole nights. Large and rapid variations do however occur, but less frequently than expected from satellite observations. This indicates that many variations in the electron energy spectrum observed by satellite borne instruments are variations in space rather than variations in time. An average over three winters shows a diurnal variation in the energy spectrum with a hardening in the spectral shape between 20 and 01 local time. An unexpected high and variable light intensity corresponding to zero riometer absorption is also discussed. (auth)

35229 (AD-612484) IONOSPHERIC RESEARCH. Quarterly Progress Report No. 5, October 1 – December 31, 1964. Webb, H. D. (Illinois Univ., Urbana. Electrical Engineering Research Lab.). Contract DA36AMC03703E. 53p. $3.00(CFSTI).

Research on the electron content of the ionosphere is outlined. The electron content is to be calculated on the basis of observations of radar reflection from the moon. Variations in the electron content are to be studied, particularly the relation of irregular variations to other natural phenomena. The reflecting surface of the moon is to be investigated also. (D.C.W.)

35230 (AD-612737) THEORETICAL INVESTIGATION OF GEOMAGNETICALLY TRAPPED ELECTRONS FROM HIGH-ALTITUDE NUCLEAR EXPLOSIONS. Report No. 3-24-64-1. Final Report. Anderson, A. D.; Crane, G. E.; Francis, W. E.; Newkirk, L. L.; Walt, M. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). June 1964. Contract DA49-146XZ204. 137p. (LMSC-895355; DASA-1480) $4.00(CFSTI).

The results of a theoretical effort directed toward the identification of the loss mechanisms responsible for the eventual removal of electrons from the trapped population are described. The principal effort is directed toward the clarification of the role of the atmosphere in removing the electrons. (CFSTI)

35231 (AD-613042) MASS SPECTROMETRY IN THE D-REGION IONOSPHERE, APPARATUS, TECHNIQUES, AND FIRST MEASUREMENTS. Narcisi, R. S.; Bailey, A. D. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Feb. 1965. 57p. (ERP-82; AFCRL-65-81) $3.00(CFSTI).

A quadrupole mass spectrometer system employing a liquid nitrogen chilled zeolite pump has recently been developed for sampling positive ions at altitudes above 50 kilometers. This system was flown successfully on a Nike-Cajun rocket on 31 October 1963 and has provided the first positive ion composition measurements in the D-region. For simultaneous environmental measurements of ion and electron densities, two spherical electrostatic analyzers were included in the rocket payload. Supplemental information of ionospheric conditions was provided by a ground-based ionosonde. Due to the high sensitivity of the system approximately twenty positive ion peaks were detected in the mass range 10 to 45 amu within the altitude range of 64 to 112 km. The predominant ions detected within the D-region (64 to 82 km) were 18(+), 30(+) and (37 ± 1)(+), with 32(+) rapidly rising above 75 km approaching the abundance of 30(+) at 83 km. At 82.5 km a sharp transition occurred in the spectra, characterized by the rapid disappearance of 18(+) and 37(+) and instantaneous appearance of six new ion peaks. Five of these ion peaks are suggested to be the metallic ions of sodium (23(+)), magnesium (24(+), 25(+), 26(+)) and calcium (40(+)). The metallic ions all exhibited an identical altitude profile, a ten (10) km-wide peak with a maximum at 95 km, a minimum at 105 km, and then continuously increasing until apogee at 112 km. (CFSTI)

35232 (LA-DC-6495) NEGATIVE SCALE HEIGHT IN IONIZED UPPER ATMOSPHERE ABOVE 4200 KILOMETERS ALTITUDE. Anderson, David N.; Bennett, Willard H. (North Carolina State of the Univ. of North Carolina, Raleigh); Hale, Leslie C. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1962]. Contract W-7405-eng-36. 5p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Laboratory calibrations and a re-evaluation of previous data for the ionized upper atmosphere above 4200 km. are presented. A diagram that shows correction of previous data is included. (M.O.W.)

35233 (LA-DC-6509) DENSITY OF THE IONIZED UPPER ATMOSPHERE TO 5500 KILOMETERS. Anderson, David N.; Bennett, Willard H. (North Carolina State of the Univ. of North Carolina, Raleigh); Hale, Leslie C. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 18p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

A re-evaluation was carried out on the flight data obtained on a four-grid ion probe in the Scout vehicle launched on Oct. 4, 1960. Laboratory calibrations of the ion probe were carried out, and the significance of the change to a negative scale height in the flight data was assessed. The results suggest that the radiation belts containing magnetically trapped high-energy particles should also contain increased densities of trapped low-energy ions and electrons. (D.L.C.)

35234 (N64-24239) INTERACTION OF TRAPPED ELECTRONS WITH THE ATMOSPHERE. Walt, M.; Newkirk, L. L. (Lockheed Missiles and Space Co., Palo Alto, Calif.). [1963]. 15p.

The time dependence of the geomagnetically trapped electron flux resulting from a high-altitude nuclear explosion was calculated assuming that the only forces perturbing the trapped electron motions are collisions with atmospheric constituents. These theoretical results are compared with experimental data obtained with satellites Injun I, Injun III, and Explorer XV. It is concluded that during the latter part of 1962 and the early part of 1963 the major loss mechanism for electrons trapped in regions of $L \gtrsim 1.25$ is atmospheric scattering but that other processes dominate the behavior of electrons trapped outside this region. Based on this quantitative knowledge of the loss mechanisms for the region $L \gtrsim 1.25$, and utilizing experimental information on the intensity and energy spectrum of the electrons in the natural Van Allen radiation belt, characteristics of the electron source function for that region are deduced. A source strength of at least 5×10^{-9} electrons cm^{-3} sec^{-1} ($E > 40$ kev) is required. The electron source is most intense for low electron energies. Both results are in disagreement with albedo neutron decay theory. (auth)

35235 (N64-25566) THE TIME DEPENDENCE OF RADIATION BELT LIFE-TIMES AND SOME APPLICATIONS (thesis). England, Forest E. (Maryland Univ.,

College Park. Dept. of Physics and Astronomy). 1964. 113p. (NASA-CR-56828). $9.60(CFSTI).

The lifetimes of particles in the radiation belt vary as a consequence of fluctuations of the loss processes such as produced by variations of atmospheric density with time. The time scale of atmospheric variations affects the averaged atmospheric density to which trapped particles are exposed and therefore determines the time dependence of the radiation lifetimes as set by the atmosphere. Since observations are usually made of the radiation flux rather than of lifetime, a number of models of injection and loss, which determine the resultant flux, are examined. Special cases of injection and removal are considered. Artificial injections such as Starfish can be used to investigate the particle lifetimes. Similarly, artificial removal by sweeper satellites modifies the radiation belt to enable physical properties of the radiation belt and its environment to be deduced. (auth)

35236 (NASA-TN-D-2874) A COMPUTER PROGRAM TO CALCULATE ARTIFICIAL RADIATION BELT DECAY FACTORS. Stassinopoulos, E. G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). July 1965. 16p. $1.00(CFSTI)

The computer code presented is a FORTRAN II Monitor-Controlled program for the IBM 7090-7094, and was developed for calculating artificial radiation-belt decay factors to evaluate the time-dependent change in the intensity of the Starfish electrons injected into the upper atmosphere on July 9, 1962. The program (called subroutine DECAY) is written in subroutine form as part of an orbital flux code for calculating omnidirectional, vehicle-encountered fluxes. Execution time for the program varies, but even in the worst case it is still insignificantly small (a fraction of a second). By means of this code, anticipated fluxes at any epoch may be predicted from known radiation levels at a given time. (auth)

35237 ABSORPTION IN THE LOWER IONOSPHERE AND PROFILE OF THE ELECTRON DENSITY FOR THE TIME OF SOLAR ECLIPSE ON FEBRUARY 15TH, 1961. Nestorov, G. Compt. Rend. Acad. Bulgare Sci., 16: 31-4 (1963).

A method is suggested for the separation of the total absorption of the waves reflected by the E-layer of non-deviated (L_D) and deviated (L_E) absorption. It is supposed that the daily deviating absorption is approximately equal to the total absorption which is obtained for the night, when the D-region is fully recombined. In order to take into account the influence of the different angles of the incoming and outgoing electromagnetic beams of the D-region to the constant vector of the terrestrial magnetic field, a modified variant of the expression for the non-deviated absorption is suggested. The initial altitude Z_0 of the D-region is determined by phase altitude measurements. For the altitude Z_1 data are used from the vertical ionospheric controlling sound. The most probable profile N(Z) could be built by numerical calculation of the integral L for assumed data for $\nu(Z)$. The results are presented from continuous recording of the coefficient of reflection by the ionosphere at inclined radiation with electromagnetic waves in a broad interval of frequencies from 155 kHz till 6037 kHz during the month of the solar eclipse on February 15th, 1961. It is established that about one half from the gyromagnetic frequency has a selective increase of the absorption. A profile of the electron density for 08^h00^m GMT for the average data for the control month of February is built as well as a profile for the same hour obtained from the data during the solar eclipse. (auth)

35238 NEW EXPERIMENTAL DATA ON THE STRATIFICATION PROCESSES IN THE IONOSPHERIC D-REGION. Nestorov, G.; Taubenheim, J. Compt. Rend. Acad. Bulgare Sci., 16: 605-7(1963).

Some characteristics of the microprocesses in the D-region are studied by measurements of the retardation between the maximum in the ionospheric effect of the Sun Flares Activity (SFA) and the maximum effect on the H_α line. An analysis of the registrations of the intensity of the electromagnetic field on a path on frequency 164 kHz and a distance of 1730 km, is carried out. Because of the specificity of the path (Sofia-Allouis, across the Alps) and the apparatus (inertless and integrationless recording) a full elimination of the side effects and influences is achieved. The attachment coefficient β of the electrons to the neutral molecules by the relaxation Δt at SFA is determined. The coefficient β proved to be dependent on the height of the lower end of D(Z), which is determined by phase altitude measurements. A method for ensuring a reliable identification of SFA and high accuracy in the calculation of β is suggested. The obtained results are confirmed by other measurements (at 16 kHz and 27 kHz) as well as by other ionospheric phenomena. (auth)

35239 MAGNETIC-IONOSPHERIC DISTURBANCES IN THE AURORAL ZONE. Pudovkin, M. I.; Skrynnikov, R. G.; Shumilov, O. I. (Polar Geophysical Inst., Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR)(English Transl.), 4: 848-52(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1094-(1964).

The relation between the intensity of geomagnetic disturbances and the absorption of cosmic radio emission is investigated. The main parameters of a disturbed ionosphere, such as the frequency of electron collisions and the ionization density, are determined. (auth)

35240 RADIAL DRIFT OF PARTICLES FROM THE RADIATION BELTS OF THE EARTH CAUSED BY HYDROMAGNETIC WAVES IN THE MAGNETOSPHERE. Shabanskii, V. P. (Moscow State Univ.). Geomagnetism Aeronomy (USSR)(English Transl.), 4: 858-60(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1108-(1964).

An explanation for the observed decrease and subsequent recovery of the intensity of high-energy electrons in the outer radiation belt during a magnetic storm is proposed in terms of particle drift produced by interactions of high-energy particles with hydromagnetic waves. It is noted that the belt can be refilled over a period of time by electrons from the decay of albedo neutrons. (D.C.W.)

35241 ACTUAL HEIGHTS OF MAXIMUM ELECTRON CONCENTRATION IN STRATIFIED FORMATIONS IN THE INTERMEDIATE E-F REGION. Serafimov, K. B. Geophysical Inst., Sofia). Geomagnetism Aeronomy (USSR) (English Transl.), 4: 871-2(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1123-(1964).

An analysis of the heights of maximum electron densities in the E-F region is summarized. The results show that changes in critical frequencies and the heights of maximum electron densities, analogous to changes in the regular ionospheric layers, occur in the stratified formations in the E-F region. (D.C.W.)

35242 GRADIENTS OF THE INTEGRAL ELECTRON CONTENT IN THE IONOSPHERE. Misyura, V. A.; Solodovnikov, G. K.; Migunov, V. M. Geomagnetism Aeronomy (USSR)(English Transl.), 4: 872-4(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1124-(1964).

The variations of the gradient of the integral electron content along beams transmitted from the Cosmos 2 satellite to the ground were studied. It was found that the tendency toward the appearance of quasiperiodic irregular variations of the total electron content with a relatively high amplitude was more pronounced for daytime than for morning and night passes. (D.C.W.)

35243 ENERGY OF GEOMAGNETIC DISTURBANCES. Afanas'eva, V. I.; Zhulin, I. A.; Kalinin, Yu. D.; Mogilevskii, E. I. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR)(English Transl.), 4: 875-8 (1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1127-(1964).

An attempt is made to estimate the accuracy and to give a possible interpretation of the values obtained previously for the integral energy of geomagnetic disturbances. (D.C.W.)

35244 INVESTIGATIONS OVER THE IONOSPHERIC E LAYER DURING THE TOTAL SOLAR ECLIPSE ON FEBRUARY 15TH, 1961. Nestorov, G.; Taubenhaim, J. Izv. Geofiz. Inst., Bulgar. Akad. Nauk, 3: 259-70(1962).

A vertical sounding of the ionosphere was performed during the total solar eclipse on February 15th, 1961, by means of ionospheric stations situated in Sofia, Nessebar, Budapest, Prague, Lindov and Juliusrou. The measuring of the solar radioemission of wavelengths 20 cm and 3 cm has been made by the radioastronomic station near the village of General Toševo. Comparing the received curve of the relative ionizing radiation to the curve of the solar radioemission at wavelength 20 cm, the effective recombination coefficient of the layer E is determined, as well as the relative intensity of the ionizing radiation of the homogeneous solar disk and on the discrete sources of ionization. The results show that the interpretation of the ionospheric observations in an immediate connection with the results of the radioastronomic measurements, is possible only in the case when the exponent of the electron density in the equation: $dN/dt = q - E\ N^2$ does not differ substantially from 2. A method is proposed for increasing the reliability for solving the equation at the initial conditions accepted. (auth)

35245 RESULTS OF THE VERTICAL IONOSPHERIC SOUNDING DURING THE TOTAL SOLAR ECLIPSE ON FEBRUARY 15TH, 1961 IN SOFIA. Serafimov, K. Izv. Geofiz. Inst., Bulgar. Akad. Nauk, 3: 279-302(1962).

The program, the method of work and the experimental results of the ionospheric investigations during the total solar eclipse on February 15th, 1961, are discussed. The vertical sounding was performed by means of an ionospheric station of type IRX-59. After establishing certain corpuscular effects of the eclipse upon the layer F and upon the night layer E, the variation of the effect of the eclipse in the depths of the layers E and F_2 is shown. The results corroborate Yuji's hypothesis of E-layer's ionization. The hypothesis is further developed and complemented with the effect on the longwave radiation. A mechanism is suggested for explaining the effects of the eclipse in the F_2-layer expressed in a transport of charged particles in its above-maximum region. Investigating the movements in the E and F_2 through a vertical section of the ionosphere and after Mounreau's method, the method is complemented by turning to real heights. Vibrational movements of the ionosphere are established, whose periods are near to the periods of the magnetohydrodynamic waves of Alfven. The neutralization constants of the layers E, F_1, F_2 and F_s are determined. A formula is derived that gives the vertical gradient in a parabolic layer. (auth)

35246 IONOSPHERIC ABSORPTION OF MEDIUM AND LONG WAVES AT THE TIME OF THE TOTAL SOLAR ECLIPSE. Nestorov, G. Izv. Geofiz. Inst., Bulgar. Akad. Nauk, 4: 85-98(1963).

A theoretical foundation of the method of measurement of the deviative and non-deviative absorption in the ionosphere of long and medium waves is given. The necessity is shown of reading the different angles β_1 and β_2 which the incident and reflected electromagnetic rays form with the vector of the constant magnetic field of the earth. According to this a modified expression of the non-deviative absorption is suggested. Continuous recording of the reflection coefficient of the ionosphere in day and night time in the month of the eclipse (February 1961) on 15 paths ranging from 155 kHz to 6037 kHz for inclined incidence of the electromagnetic wave (method AZ) is carried out. A frequency dependence of the absorption with maximum for frequencies about half the gyrofrequency is established. On the basis of data for the non-deviative absorption on medium waves and the deviative on long waves, profiles are constructed for the distribution of the electron density in the D-layer during the control period and at the time of the totality of the solar eclipse (08 GMT). (auth)

35247 VARIATION OF THE IONOSPHERIC REFLECTION BY THE NIGHT E-LAYER FOR MODERATE GEOGRAPHICAL LATITUDES. Nestorov, G. Izv. Geofiz. Inst., Bulgar. Akad. Nauk, 4: 99-108(1963).

The night E-layer is investigated by long-term continuous recording of the field intensity of radiofrequency 155 kHz for inclined irradiation ($f_i \approx 70$ kHz). The method of measurements, the apparatus and the characteristics of the investigated path, are discussed. A characteristic annual variation of the coefficient of reflection by the night E-layer with two maxima near the vernal and autumnal equinoxes and a slight winter minimum, is established. The latter agrees well with the general conceptions about the ionization of the earth atmosphere, but the summer minimum shows that some nonsolar sources take part in the ionization of the night E-layer. Such ionizing agents could be the cosmic rays. It is shown analytically that from the available data for the ionizing function q_{cr} of the cosmic rays and for the profile of the coefficient of negative ions λ a stratificated formation is obtained with a maximum height of about 95 km. Close correlation for a period of 4 years of the coefficient of reflection ρ with the relative intensity of the meson component, is established. The comparison of the data for the geomagnetic activity ρ with the meson and the neutron components confirms the considerable probability for the formation of an essential part of the ionization of the night E-layer by cosmic rays. The explanation of the summer anomaly by absorption of the ionizing remnants in the region D during the summer leads to a considerable discrepancy in the consequences and is therefore rejected. (auth)

35248 SOME REGULARITIES OF THE E_2-LAYER OVER SOFIA DURING 1961. Samardziev, D.; Serafimov, K. Izv. Geofiz. Inst., Bulgar. Akad. Nauk, 4: 109-25(1963).

The characteristics of the signal reflected by the intermediate E-F region of the ionosphere defined as F_2-layer is discussed. The examination is made on the basis of three basic symptoms: process of appearance of the layer, its position in the space, and its connection with the upper part of the E-layer and the low frequency tail of the F-region. The distinctive features by which the radio reflection is classified are specified. On the basis of material collected for a year of observations (1961), in Sofia, a season histogram for the frequency of appearance of E_2-layer is obtained. A sharp minimum is established during the summer and maximum during the winter. The intermediate layer E_2 is a dynamical formation with considerable fluctuations of the electron density with time and space. For the month with maximum repeatability the daily variation of critical frequencies for E_2, which show a negligible dispersion, is determined. The most probable time for the appearance of the E_2-layer is between 9 and 10 o'clock a.m. local time. The distribution of the electron concentration (the critical frequency resp. with time) is subordinated to the law $f_0E_2 \sim (\cos x)^n$ where the exponent n is smaller than that corresponding to the E-layer. This particularity explains the disappearance of the reflection in summer because of the shielding of E_2 by the normal layer E, whose critical frequencies during this season increase much more rapidly than f_0E_2. (auth)

35249 IONOSPHERIC F-LAYER AT THE TIME OF THE SOLAR ECLIPSE ON FEBRUARY 15TH, 1961. Taubenheim, Jens; Serafimov, K. Izv. Geofiz. Inst., Bulgar. Akad. Nauk, 4: 127-36(1963).

The basic causes for the versatile behavior of the F-region at the time of solar eclipses, and in particular the behavior of the F_2-layer are shown. Because of the difficulties in the correct interpretation of the effects of the eclipse in the F_2-layer, an analysis from several ionospheric stations is carried out. By this way an objective evaluation is reached of the influence of the faded ionization agent in the F_2-layer which is expressed in lowering of the electron density in the region of maximum density of the same layer. The correlation of this lowering for the separate stations is good and it is observed only in the period of the eclipse on February 15th, 1961. The effects of the eclipse are better expressed in the F_1-layer. It is

established that the eclipse contributes to the stratification of the region F. The variation of the critical frequencies $f_0F_1(t)$ is similar to the variation of $f_0E_0(t)$. Aftereffects of the eclipse are established on the basis of the analysis of the ionograms, obtained in the afternoon hours on February 15th, 1961, expressed in lowering of the normal level of the afternoon ionization. It is established that the eclipse that takes place in the morning hours of the day influences the ionization balance during the whole day. (auth)

35250 THE INFLUENCE OF THE NIGHT E-LAYER ON THE NIGHT GLOW. Serafimov, K. B. Izv. Geofiz. Inst., Bulgar. Akad. Nauk, 4: 151-61(1963).

A considerable part of the intensity of the night air glow falls on its spectral components $\lambda = 5577$ Å and the red multiplet. An essential part of this radiation originates from regions situated above the night E-layer. The energy of the green line and the first red line ($\lambda = 6300$ Å) is enough for the photodissociation of negative oxygen ions. The absorption of the above mentioned radiations in crossing the low night ionosphere is evaluated. It is shown that this absorption could lead to considerable errors in determining the actual intensity of the generation processes. In presence of photodissociation in the night E-layer a lower value for the equilibrium between electrons and negative ions is established by which the electron concentration on this layer is indirectly increased. When the absorption of the night air glow in the lower ionosphere is taken into account, the anomalous night variation of the intensity of the earth oxygen line could be explained as well as some contradictions between theory and experiment in this field. The established corpuscular effects of the solar eclipse on February 15th, 1961, in the night E-layer are considered as a confirmation of the suggested hypothesis. The error of not taking into account the absorption in the lower ionosphere exceeds many times the possible error from extinction, scattering in the troposphere and absorption in the ozonosphere. (auth)

35251 ON THE CONTINUITY EQUATION FOR ELECTRON DENSITY IN THE IONOSPHERE. Shimazaki, Tatsuo (National Bureau of Standards, Boulder, Colo.). J. Atmospheric and Terrest. Phys., 27: 593-604(May 1965).

The continuity equation for electron density is discussed by considering some representative chemical reactions in the ionospheric regions. Without neglecting the time-dependent and the transport terms, the equation is modified so that the decay term has a form of $L = \gamma[X_2]/\{N_e + (\lambda/\alpha)[X_2]\}$, where α and λ are the rate coefficients of dissociative recombination and ion-atom interchange reactions, respectively, and the remaining terms are formulated. It is found by rather rough tests that these remaining terms are small, and the continuity equation with the decay term of L-type function, which is usually used for the discussion of steady state, may be used for the non-steady state cases without serious errors. In some cases, however, these remaining terms may be appreciable, and their effects on the continuity equation for electron density may not be neglected. Finally, some detailed formulations for equilibrium electron density are given. (auth)

35252 POST-STORM COSMIC RAY INCREASES AND THE RADIATION BELT. Tandon, J. N. (Univ. of Delhi); Bhatia, V. B. J. Atmospheric and Terrest. Phys., 27: 635-40(May 1965).

Post-storm cosmic ray increases observed recently by Tandon (1961a) have been studied following a Chree analysis for the neutron intensity data of fourteen selected stations for the I.G.Y. period. These increases are shown to be the general feature of all geomagnetic storms especially those followed by a long quiet-period. They may have their origin in the outer radiation belt. The local acceleration mechanism in the outer radiation belt has been developed which correlates these increases with the recent satellite observations of the outer radiation belt during a geomagnetic storm. (auth)

35253 A NOTE ON THE THEORY OF EQUATORIAL SPORADIC-E. McIlroy, D. K. (Univ. of Queensland, Brisbane, Australia). J. Atmospheric and Terrest. Phys., 27: 641-3(May 1965).

It is shown how the essential results of Farley's theory of equatorial sporadic-E can be predicted from simple theory and how the simple theory exhibits the physical mechanism underlying Farley's theory. It is concluded however that Farley's more elaborate theory is necessary to predict the observed wavelength dependence of the E_s irregularities. (auth)

35254 SOLAR CYCLE AND SEASONAL VARIATIONS IN THE EQUATORIAL IONOSPHERIC F-REGION. Ganesh, K. S. (Kodaikanal Observatory, India). J. Atmospheric and Terrest. Phys., 27: 645-55(May 1965).

Representative (N−h) profiles were obtained from Kodaikanal ionograms covering a period of about one solar cycle for the study of the effect of solar activity on the ionic densities at different levels in the equatorial ionosphere. The seasonal and Far East anomalies were also examined. Using the profiles, the total electron content ($n_T = \int Ndh$) in the F-region was evaluated for a study of the diurnal asymmetry. The effective ratio "R_e" = $\int Ndh$ above $h_{max}/\int Ndh$ below h_{max} and the slab thickness τ of the layer were also evaluated, and the results are discussed. (auth)

35255 DIFFUSION IN THE F2-REGION. Varnasavang, V. (London Univ.). J. Atmospheric and Terrest. Phys., 27: 657-61(May 1965).

A recent paper by Ferraro on the ionospheric diffusion in the F2-region is extended to include the ion-electron collision term in the equations of motion for the ions and electrons. It is shown that the neglect of such terms in Ferraro's paper is well justified. In addition to the results given by Ferraro, it is found that a very small electric current is generated, due to unequal drifts, in a meridian plane containing a line of force. (auth)

35256 LUNAR DAILY VARIATIONS OF HORIZONTAL DRIFTS IN THE E- AND F2-REGIONS. Rao, A.; Rao, Sanyasi; Ramachandra, B. (Andhra Univ., Waltair, India). J. Atmospheric and Terrest. Phys., 27: 661-3(May 1965).

A large volume of horizontal drift data obtained by the spaced-receiver method was utilized to study the lunar effect on E- and F2-region horizontal drifts. A comparison of results obtained with those of others clearly show a certain regularity in the latitude variation of the amplitudes and phases of the north-south and east-west 12-hourly lunar drifts; this is an increase of these components from low values to a maximum at 45° and then a decrease. However, this conclusion requires strengthening by further data. (J.F.P.)

35257 SOLAR FLARE CROCHET AND SUDDEN COMMENCEMENT IN H WITHIN THE EQUATORIAL ELECTROJET REGION. Rastogi, R. G.; Kaushika, N. D.; Trivedi, N. B. (Physical Research Lab., Ahmedabad, India). J. Atmospheric and Terrest. Phys., 27: 663-8(May 1965).

The amplitudes of solar flare crochets and sudden commencements of magnetic storms in the horizontal component occurring during the daylight hours at the Peruvian and Indian stations were studied. Such studies show that the current system for these two phenomena may not be identical. The stronger equatorial enhancement of the crochets than of the sudden commencements of magnetic storms indicates that the solar flare current system is situated at a lower height than the sudden commencement system. (J.F.P.)

35258 SEASONAL AND LONGITUDINAL F2-REGION ANOMALIES IN RELATION TO OCCURRENCE OF BLANKETING SPORADIC-E. Bhargava, B. N. (Kodaikanal Observatory, India). J. Atmospheric and Terrest. Phys., 27: 668-71(May 1965).

For any consideration of seasonal and longitudinal anomalies of the F2-layer in the equatorial ionosphere, notice must be taken of increased occurrence of blanketing in the East and in the Far East. It is found that in view of relatively large incidence of blanketing in the equatorial region

of the East hourly, and monthly mean or median values of the maximum reflection frequency of sporadic-E layer are not representative of the equatorial blanketing, and that the use of such published values can lead to a serious overestimation of the strength of the equatorial blanketing particularly during the summer. (J.F.P.)

35259 EFFECT OF IONIZATION TRANSPORT ON THE EQUATORIAL F-REGION. Bramley, E. N.; Peart, M. (Radio and Space Research Station, Slough, Bucks, Eng.). Nature, 206: 1245-6(June 19, 1965).

Calculations on the effects of ionization transport on the equatorial F-region of the ionosphere are discussed. It is noted that electromagnetic drift speeds of only a few m/sec are required to produce an anomaly of the magnitude actually observed. It seems likely that diurnal variations in the electric field, and hence the drift speed, may be significant in determining the marked diurnal variation of the equatorial anomaly. (P.C.H.)

35260 EVALUATION OF THE X-RAY PRIMARY OMNIDIRECTIONAL FLUX FROM MEASUREMENTS AT BALLOON ALTITUDES. Brini, D.; Ciriegi, U.; Fuligni, F.; Gandolfi, A.; Moretti, E. (Universita, Bologna). Nuovo Cimento (10), 38: 130-40(July 1, 1965).

In a program of measurements by directional detectors for (20–200) kev x rays at balloon altitudes, the possibility to put in evidence the primary omnidirectional x-ray flux has been considered in order to have an evaluation of its order of magnitude as preliminary phase of a rocket experiment to be made in 1965. Experimental method and results obtained are here described. The upper and lower limits were estimated respectively in about 0.6 $x/cm^2 \cdot s \cdot sr$ and about 0.15 $x/cm^2 \cdot s \cdot sr$, which seem to be consistent with the data in other energy ranges. (auth)

35261 CYCLOTRON HARMONIC RESONANCES OBSERVED BY SATELLITES. Shkarofsky, I. P.; Johnston, T. W. (RCA Victor Research Labs., Montreal). Phys. Rev. Letters, 15: 51-3(July 12, 1965).

An explanation is given of the asymptotic time behavior of the local plasma and magnetic-field-resonance phenomena observed by satellite topside sounders. The Vlasov plasma waves are considered whose group velocities are equal or nearly equal to the satellite velocity. (J.F.P.)

35262 A THEORY OF THE RADIATION BELT. Kundu, S. K. (Australian National Univ., Canberra). Planetary Space Sci., 13: 473-84(June 1965).

A theoretical investigation of the properties of a plasma in the vicinity of a magnetic dipole is made, and the conditions for stability of the plasma derived and applied to the earth's radiation belt. During solar flares oscillations may be set up in the plasma, and the frequency of such oscillations is calculated. A comparison is made between the theoretical frequency and the frequency of the fluctuation observed by the space probe, Pioneer IV. The current and density observed in the newly discovered third radiation belt at 8-10 earth radii are shown to be consistent with the present theoretical estimate. The present method also provides an explanation of magnetic storms and shows the possibility of considering the effect of interaction between the dipole field and current in the belt, a feature which is difficult to consider in the microscopic theory. (auth)

35263 LOW FREQUENCY HYDROMAGNETIC WAVES IN THE MAGNETOSPHERE: EXPLORER XII. Patel, V. L. (Univ. of New Hampshire, Durham). Planetary Space Sci., 13: 485-506(June 1965).

Low frequency hydromagnetic waves are studied in the magnetosphere by using the Explorer XII magnetometer observations. A method is developed to separate transverse Alfvén and magnetosonic waves from the satellite results. Several waves of 10 gamma amplitude and 100 to 200 second period are found. The transverse waves are circularly and elliptically polarized. Evidence of transverse waves originating in the magnetosphere and propagated to the surface of the earth is found. A model is presented to explain the generation of such waves in the magnetosphere. This study of the hydromagnetic waves in the magnetosphere covers 7 to 10 earth radii in radial distance and 76 degrees from the sun–earth line toward morning side in longitudinal extent, close to the geomagnetic equator. Polarizations of transverse waves are dependent on local time. It is found that the polarization directions are opposite in sense about 1045 and not 1200 hours local time. Direct evidence for such an asymmetry, suspected from several ground observations, is found for the first time in the magnetosphere. (auth)

35264 INTEGRATED ELECTRON PRODUCTION AND LOSS RATES IN THE IONOSPHERE. Taylor, G. N. (Univ. of Manchester, Eng.). Planetary Space Sci., 13: 507-20(June 1965).

The deduction of the rate of change of electron content with local time from lunar radar Faraday rotation observation is discussed, and the equation of continuity for the electron content is given. The equation of continuity reduces to a simple form, using a simple model electron density profile and assuming height dependent attachment-like loss at all levels. The rate of decrease of electron content after sunset obtained from observations at Jodrell Bank shows good order of magnitude agreement with the predictions from the simplified continuity equation; some fairly small, apparently systematic, deviations from the predicted loss rates are discussed. The integrated rate of production of electrons was measured just after dawn and shows well marked variations with season and solar activity. There is some evidence that both the loss coefficient and the total production rate reduced to normal incidence have considerable diurnal variations. An upper limit of 2×10^{12} $c/m^2/sec$ can be set to the time averaged rate of production of electrons in situ during the night. The observations are not inconsistent with the existence of a downward flux of electrons from the exosphere. (auth)

35265 THE MORPHOLOGY OF AURORAL PRECIPITATION. Piddington, J. H. (CSIRO, Sydney). Planetary Space Sci., 13: 565-77(June 1965).

The wide field of auroral precipitation studies is reviewed with the object of relating them to a model magnetosphere and understanding the processes involved. The studies comprise visual and photographic observations of discrete auroras, spectral measurements of ionospheric emissions and of incoming hydrogen, balloon observations of x rays, measurements of ionospheric absorption of radio waves, and direct measurements from satellites and rockets of precipitated particles; closely related studies include geomagnetic agitation and ionospheric sporadic-E and spread-F. Different precipitation phenomena have widely different global patterns and different spectra of incoming electrons. On this basis three zones of precipitation are recognized and defined for an average (quiet) level of geomagnetic activity. Zone I lies approximately between parallels of geomagnetic latitude 63 and 73° with precipitation strongest in the dawn hemisphere. Harder electrons ($E \gtrsim 100$ kev) are precipitated at lower latitudes ($\approx 65°$) to provide radio absorption, blackouts, and x-ray events without much visual emission. Softer electrons ($E \gtrsim 20$ kev) are seen at higher latitudes ($\simeq 68°$) to cause mantle auroras. Much the same distribution is observed from satellites and rockets. Zone II overlaps Zone I near midnight but extends poleward beyond 80° near noon. It is the zone of discrete visual auroras which have maximum occurrence near midnight but also occur during the day; other phenomena (sporadic-E, spread-F, magnetic agitation, Hα) show similar distributions. The particles responsible are mainly electrons of even lower energy ($E \gtrsim 10$ kev), but much larger fluxes and much larger total energy. Zone III falls within Zone II and is the region of polar auroras, which have some unique characteristics. The separation of Zone I and II phenomena may reconcile earlier auroral distributions, some of which fell into the classical auroral zone (lat. ~68°) and some of which showed spiral forms. They appear to have significance in connection with a model magnetosphere, Zone I lying within the magnetosphere proper and Zone II defining the region of transition into the tail. Zone III is connected to field lines within the tail. (auth)

35266 CONJUGATE OBSERVATIONS OF SOLAR PROTON EVENTS: DELAYED IONOSPHERIC CHANGES DURING TWILIGHT. Chivers, H. J. A.; Hargreaves, J. K. (National Bureau of Standards, Boulder, Colo.). Planetary Space Sci., 13: 583-92(June 1965).

Solar proton events were observed, as polar cap absorption, with riometers operating simultaneously at a set of stations, some conjugate, in the northern and southern hemispheres. Comparisons of the records from stations in twilight with a station which is continuously sunlit allow an accurate determination of the changes during twilight, since changes due to the proton flux are monitored by the sunlit station. The method also allows accurate determinations of the day-to-night ratio to be made. It is found that after sunrise there is a time delay of several hours before the absorption reaches the full daylight value. There is also some evidence for a time delay after sunset. It appears that these results cannot be fully understood in terms of the aeronomy of the D region as it is known at present, and it is suggested that some other photochemical process, not yet identified, might be involved. (auth)

35267 SPACE RESEARCH. V. Proceedings of The Fifth International Space Science Symposium, Florence, May 12–16, 1964. King-Hele, D. G.; Muller, P.; Righini, G. (Eds.). Proc. Intern. Space Sci. Symp., 1964, 5: (1965). New York, John Wiley and Sons, Inc., 1965. 1262p. $47.50. (CONF-521).

One-hundred-fifty-three papers are included; separate abstracts were prepared for 59. Five papers were previously abstracted for NSA; see 18: 24515, 24749, 30649, 44389, 19: 14199. (L.B.S.)

For abstracts of individual papers see: 34916, 34917, 34918, 34919, 34920, 34921, 34922, 35268, 35269, 35270, 35271, 35272, 35273, 35274, 35275, 35276, 35277, 35278, 35279, 35280, 35281, 35282, 35283, 35284, 35285, 35286, 35287, 35288, 35289, 35290, 35291, 35292, 35293, 35294, 35295, 35296, 35297, 35298, 35299, 35300, 35301, 35302, 35303, 35304, 35305, 35306, 35307, 35308, 35309, 35310, 35311, 35312, 35313, 35314, 35315, 35316, 35317, and 35318.

35268 MAINTENANCE OF THE NIGHT IONOSPHERE AND CORPUSCULAR FLUXES IN THE UPPER ATMOSPHERE. Ivanov-Kholodny, G. S. Proc. Intern. Space Sci. Symp., 1964, 5: 19-42(1965).

The results of rocket and satellite investigations of electron density in the night ionosphere are reviewed. Various mechanisms determining the maintenance of the night ionosphere, due to residual day-time ionization conservation, due to diffusion and due to corpuscular fluxes are considered. Recent laboratory data on photochemical processes and recombination coefficient are presented; their application to the ionosphere is discussed. (auth)

35269 ON THE MECHANISM OF MAINTENANCE OF THE NOCTURNAL IONOSPHERE. Krassovskii, V. I.; Truttse, Yu. L.; Shefov, N. N. (Inst. of Physics of the Atmosphere, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 43-48(1965).

From an analysis of data on the corpuscles and emissions of the upper atmosphere, the view-point is re-affirmed that at nighttime over mid-latitudes, under ordinary conditions, the role of corpuscular ionization in the F-region is negligible, and that the nocturnal ionosphere may be a remnant of the daytime ionosphere in view of the low effective recombination rate at nighttime. Corpuscular ionization, however, is a common occurrence in the auroral zone, and, possibly, appears sporadically in the region of low latitudes, accompanying such phenomena as feeble red arcs and patches. (auth)

35270 MAINTENANCE OF IONIZATION IN THE NIGHTTIME F_2 REGION. Yonezawa, T. (Radio Research Labs., Tokyo). Proc. Intern. Space Sci. Symp., 1964, 5: 49-60 (1965).

The peak electron density of the F_2 layer observed in middle and higher latitudes in winter during periods of low solar activity maintains almost a constant value during the night except for a few hours just after sunset. The slow downward diffusion of electrons and ions from the exosphere along geomagnetic lines of force may well explain this phenomenon. The steady-state solution of the continuity equation of electrons corresponding to this situation was obtained and a relaxation is derived between the peak electron density and the downward flux of electrons and ions. A flux of about 5×10^7 cm^{-2} sec^{-1} will suffice to maintain the peak electron density of 10^5 cm^{-3}. The solution also shows that the electron density distribution is very similar to an α-Chapman distribution and that the peak electron density is situated at a level somewhat higher than that of a normal F_2 layer at sunset. A formula is derived giving the height of peak ionization in terms of atmospheric scale height and other relevant parameters and predicting a rise or fall of the level of peak ionization accompanying an increase or decrease in atmospheric temperature, which is substantiated qualitatively by observational data. As regards the latitudinal distribution of the constant value of the peak electron density of the F_2 layer during the night, it shows a more intimate association with geomagnetic latitude than with geographic latitude and has a minimum around 50° ~ 50°N geomagnetic latitudes in the northern hemisphere and a broader minimum around 50° ~ 75°S geomagnetic latitudes in the southern hemisphere. (auth)

35271 POSSIBILITY OF DETECTION OF HIGH ENERGY PARTICLES IN THE UPPER ATMOSPHERE BY THE OBSERVATION OF THE NOCTURNAL LUMINESCENT ATMOSPHERE. Barbier, D. (Institut d'Astrophysique, Paris). Proc. Intern. Space Sci. Symp., 1964, 5: 61-70(1965). (In French)

Since high-energy particles in the high atmosphere are the primary cause of the excitation of high-altitude aurorae (i.e. classic aurorae), it is investigated whether low-altitude aurorae form a transition between normal aurorae and nightglow. This proves not to be the case. Nightglow, as is generally assumed, belongs to a totally different category of phenomena. Calculations are given which permit the determination (by non-observation of certain lines of nightglow) of maximum values of energy particle flux in the high atmosphere. Simultaneous observations of the intensity of the 6300-line and of electronic profiles in the ionosphere show that the structure of the F-layer, at least at a low altitude level, is essentially conditioned by displacement of the ionized matter, which throws doubt on the importance of fast-moving particle flux for maintaining the nighttime ionosphere. (auth)

35272 PROBLEMS RELATING TO THE POWER OF AURORAE. Krassovskii, V. I. (Inst. of Physics of the Atmosphere, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 71-76(1965).

The power of aurorae attains such enormous values as 10–100 erg cm^{-2} sec^{-1}. Two types of luminescence seem to occur: that due to excitation of the ionosphere by thermal electrons (with evolution of Joulian heat or with dissipation of magnetohydrodynamic waves), and that due to direct excitation by corpuscles. Luminescence is most powerful in the case of excitation by electrons, not protons. It is accompanied by heating and expansion of the upper atmosphere in the auroral zone. On the basis of energy considerations aurorae can not be explained by the outflow of particles from the radiation belts. Hypotheses assuming permanent acceleration of corpuscles within the radiation belts during aurorae are untenable in view of the absence of a stock of low-energy particles (i.e. the material for acceleration) in the region of these belts. The possibility is not excluded that the corpuscles of aurorae are formed on account of the interplanetary plasma or solar wind, when its own magnetic field combines with that of the Earth. If this is the mechanism, the outer corpuscles of the radiation belt are destroyed in the course of aurorae. What is registered in the outer zone in the period between aurorae is a negligible remnant of the corpuscles appearing during these phenomena. (auth)

35273 THE TEMPERATURE OF CHARGED PARTICLES IN THE UPPER ATMOSPHERE. Bourdeau, R. E. (Goddard Space Flight Center, Greenbelt, Md.). Proc. Intern. Space Sci. Symp., 1964, 5: 77-90(1965).

Three general methods of investigating charged particle temperatures in the upper atmosphere have been used: direct measurements from rockets and satellites; indirect determination using electron scale heights measured from rockets and satellites; ground-based radar incoherent backscatter experiments. The latitude, altitude and temporal trends of these results are reviewed and the implications discussed. Observations by all three methods are consistent in showing that the electron temperature increases with latitude for both daytime and nighttime conditions. Moderate differences between the daytime electron and neutral gas temperatures are indicated to altitudes well above the F_2 peak for a winter mid-latitude ionosphere at an epoch between solar maximum and solar minimum conditions. Much larger daytime differences are observed for summer months and for solar minimum conditions. All of these trends reflect corresponding changes in the electron density. The daytime observations are consistent with ultraviolet radiation as the predominant heat source if the possibility of photoelectrons diffusing along magnetic field lines and depositing their excess energy elsewhere is included. A nighttime heat source small compared to the daytime ultraviolet effect is required to explain the observations. (auth)

35274 AURORA AND THE LOWER IONOSPHERE IN RELATION TO SATELLITE OBSERVATIONS OF ELECTRON PRECIPITATION. Hultqvist, B. (Goddard Space Flight Center, Greenbelt, Md.). Proc. Intern. Space Sci. Symp., 1964, 5: 91-117(1965).

The direct observations of electron precipitation by means of rockets and satellites are reviewed. Upon comparison of the observed energy fluxes with those expected on the basis of optical measurements of aurora, the agreement is found to be good. It is demonstrated that the satellite observations make understandable the observed variable degree of correlation between visual aurora and auroral absorption of radio waves. The precipitated electrons contribute significantly to the nighttime ionosphere not only in the auroral zone but also over the polar caps and in subauroral latitudes. It does not seem impossible that the observed precipitation of electrons is the main source of the nighttime ionization in the lower ionosphere. The airglow is briefly discussed in relation to observed particle precipitation. Finally, the recent demonstrations of the insufficiency of the Van Allen belt as a source for the precipitated electrons are briefly reviewed. (auth)

35275 THE DISSIPATION OF HYDROMAGNETIC WAVE ENERGY IN THE IONOSPHERE. Dessler, A. J. (Rice Univ., Houston, Tex.). Proc. Intern. Space Sci. Symp., 1964, 5: 119-24(1965).

The basic concepts of ionospheric heating by hydromagnetic waves are reviewed. Experimental data on the hydromagnetic wave power spectrum are not available. Therefore, the possible geophysical importance of this mechanism can not be evaluated quantitatively. It is tentatively concluded that hydromagnetic heating may be important during geomagnetically active periods but not during quiet periods. (auth)

35276 ON THE FIRST PHASE OF A MAGNETIC STORM. Shabanskii, V. P. (Academy of Sciences, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 125-47 (1965).

It is asserted that the boundary of the magnetosphere contracts in the course of the first phase of a magnetic storm with sudden commencement. This leads to the fact that the increase of the horizontal component of the field, caused by the eastward surface current on the magnetosphere boundary, becomes more effective even without a considerable increase in this current. Some quantitative difficulties occurring because of the small actual pressure of the flux can be therefore eliminated. (auth)

35277 A HYDROMAGNETIC AND THERMODYNAMIC PICTURE OF A MAGNETIC STORM. Shabanskii, V. P. (Academy of Sciences, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 148-60(1965).

The following picture of the magnetic storm is considered. A shock wave which propagates from the Sun along the interplanetary gas (or a solar corpuscular flux) greatly warms up the interplanetary gas in the vicinity of the terrestrial magnetosphere. The magnetosphere, being compressed by the corpuscular flux, is warmed much less because of the strong magnetic field within its limits. Almost adiabatic compression of the magnetosphere during this period is identified with the first phase of the storm. The magnetosphere is warmed in time by noncollision-born magnetohydrodynamic waves generated on the magnetosphere boundary. As the effective temperatures on the magnetosphere and in the flux become equalized, expansion of the magnetosphere occurs, despite the fact that the pressure in the flux might not fall. The relative expansion of the magnetosphere then exceeds considerably the initial compression. The quantities of energy transferred by hydromagnetic waves in the course of the process are sufficient for the creation (or amplification) of a ring current which is responsible for the main phase of the storm. (auth)

35278 FIELD ALIGNED STRATA IN THE UPPER IONOSPHERE. Sayers, J. (Univ. of Birmingham, Eng.). Proc. Intern. Space Sci. Symp., 1964, 5: 161-70(1965).

A major advance in our knowledge of the ionosphere has been the recognition in the past decade of the influence of the geomagnetic field on the distribution of ionization, particularly in the upper F_2 region. This influence was first appreciated, several years ago, in the form of field aligned irregularities in the F_2 region. Anomalies were indeed observed in the distribution of ionization density with latitude considerably earlier but the geomagnetic significance of these observations was not, at the time, fully appreciated. With the successful missions of the satellites Ariel 1 and Alouette it was discovered that field alignment of ionization, of a much more extensive and regular character than the earlier F_2 features, existed in the topside ionosphere. Ground-based observations of the topside ionosphere by the incoherent scatter technique of the National Bureau of Standards group at Lima have added further data which support the idea of field aligned ionization strata on a world-wide basis. Observations with the satellite Ariel 1 indicate that there are three of these strata on separate geomagnetic shells. Corpuscular radiation detectors on a number of other satellites have indicated that this form of radiation is probably responsible for at least some of the field aligned ionization enhancement. Many problems, however, remain unanswered and the complete understanding of the geomagnetic control of the topside ionosphere must await much further theoretical and observational work. For example, recent observations of the high altitude air glow and red arcs indicate a geomagnetic dependence and suggest a relationship with the field aligned ionization which must be explored. (auth)

35279 DIRECT SATELLITE PROBE MEASUREMENTS OF IONOSPHERIC IRREGULARITIES. Ulwick, J. C.; Pfister, W.; McInerney, R. E. (Air Force Cambridge Research Labs., Bedford, Mass.). Proc. Intern. Space Sci. Symp., 1964, 5: 171-8(1965).

A standing wave impedance probe was flown on polar orbiting satellites through the F_2 layer. Continuous measurements for entire orbits were recorded and stored on magnetic tape. Perigee was around 220 km near the equator at about 1700 hours local time, apogee was at 400 km and 700 km, respectively. In studying the profiles through the F region, irregularities superimposed on the gross features of the ionosphere were found. In the lower F region irregularities of a size in the order of 400 km are noted with intensity fluctuations between 5 and 10 percent. There is a tendency for these irregularities to be larger in the vicinity of the magnetic equator. Above the peak of the F layer, pronounced fluctuations due to auroral structures and large

scale irregularities were observed. One system of irregularities appears to be aligned with the magnetic latitude, while another structure appears consistently at a geographic latitude near 70°. (auth)

35280 GENERATION OF VLF RADIO NOISE IN THE IONOSPHERE BY ENERGETIC PARTICLE STREAMS. Helliwell, R. A. (Stanford Univ., California). Proc. Intern. Space Sci. Symp., 1964, 5: 179(1965).

Mechanisms based on individual particle radiation and collective mechanisms, which include various types of traveling-wave amplification and the non-convective transverse gyro-resonance plasma stability, are noted. (L.B.S.)

35281 SOME EFFECTS OF ELECTROMAGNETIC DISTURBANCES ON THE RADIATION BELTS. Dungey, J. W. (Imperial Coll., London). Proc. Intern. Space Sci. Symp., 1964, 5: 183-4(1965).

A theoretical treatment is presented on the effects of electromagnetic disturbances on radiation belts. Order-of-magnitude calculations are made for the effect of a particular disturbance on an individual particle. (L.B.S.)

35282 SATELLITE MEASUREMENTS OF THE DIURNAL VARIATION OF ELECTRON TEMPERATURES IN THE F REGION. Sagalyn, R. C. (Air Force Cambridge Research Labs., Bedford, Mass.); Smiddy, M.; Bhargava, Y. N. Proc. Intern. Space Sci. Symp., 1964, 5: 189-206 (1965).

Simultaneous measurements of electron temperatures and densities were obtained in the F region with spherical electrostatic analyzers mounted on two Air Force satellites with polar, nearly circular orbits. Large diurnal variations of electron temperature are observed between 200 and 330 km. This is characterized by sharp increase in electron temperature of the order of 2000° within two hours after ionospheric sunrise. At ground sunset a rapid decrease of electron temperature, T_e, commences. The rate of change of T_e is, however, an order of magnitude smaller than at sunrise. After ionospheric sunset, the temperature decrease with time is greatly reduced; a minimum of 1000 ± 200°K is measured before sunrise. Above 200 km, the rapid change in temperature at sunrise and sunset is accompanied by over an order of magnitude change in electron density. Below 200 km the amplitude of the diurnal variation of T_e decreases rapidly with altitude. Over the latitude range ±75° variations of temperature with local time are greater than the variations with latitude; however, there are observed small but significant increases in temperature and charge density in the southern hemisphere which are correlated with geomagnetic position. Application of analyses of Dalgarno et al. and Hanson to the results shows that the daytime heat input required to maintain the observed difference between the electron and neutral gas temperatures agrees to within a factor of 2 with the available data on the heat input due to solar uv. This is the magnitude of the experimental and theoretical uncertainties. (auth)

35283 POSITIVE ION TEMPERATURES ABOVE THE F-LAYER MAXIMUM. Boyd, R. L. F.; Raitt, W. J. (University Coll., London). Proc. Intern. Space Sci. Symp., 1964, 5: 207-11(1965).

The ion mass analyser on the UK–US satellite Ariel was a spherically symmetric energy spectrometer. The spectral lines may thus be interpreted not only in terms of ionic mass and concentration but also in terms of ion temperature. Analysis of the data obtained has made available a picture of ion temperature variation with latitude above 400 km. The results show considerable scatter from day to day together with a marked rise in oxygen ion temperature with latitude. (auth)

35284 INFLUENCE OF PARTICLES ON CERTAIN IONOSPHERIC IRREGULARITIES. PART I. ON CERTAIN GUIDED ECHOS OBSERVED BY IONOSPHERIC SOUNDINGS BY SATELLITES. Du Castel, F. (Centre National d'Etude des Telecommunications, Issy-les-Moulineaux, France). Proc. Intern. Space Sci. Symp., 1964, 5: 216-28(1965). (In French).

An interpretation of some long distance echoes observed by Alouette satellite is suggested. The conditions required for a ducted propagation, due to the existence of a field-aligned sheet of ionization, depend on the curvature of the line of force and on the phase coherence of the ducted radiation. These conditions introduce cut-off frequencies, depending on the gradient of ionization and on the size of the sheet. Two types of echoes could be separated, from the frequency band occupied in the ionogram. These types are interpreted by ducting propagation either when the satellite is inside the duct or when it is outside. The observed cutoff frequencies allow a computation of the sheet's characteristics. The dimensions are about a few percent for the variation of ionization and a few kilometers for the transversal size of the sheet. This interpretation is compared with other proposals. It is pointed out that such kind of echoes are not only observed in equatorial regions but at middle latitudes too. (auth)

35285 INFLUENCE OF PARTICLES ON CERTAIN IONOSPHERIC IRREGULARITIES. PART II. ON CERTAIN TRAVELLING DISTURBANCES IN THE UPPER AND LOWER IONOSPHERE. Faynot, J. M. Proc. Intern. Space Sci. Symp., 1964, 5: 229-40(1965). (In French).

Results obtained during March 1963 by a European network of ionosondes, and simultaneous Alouette topside ionograms are presented. These results show that traveling disturbances observed in the lower ionosphere appear at the same time in the upper ionosphere on field aligned irregularities of ionization. This correspondence leads us to consider an external contribution in addition to the coherent system propagated by gravity waves. As the latitude range of maximum occurrence of these irregularities corresponds to the lower edge of the trapped radiation belts, and as its northern border in Europe coincides with the subauroral zone of enhanced spread F, it must be due either to trapped particles, or to the influence of ionospheric current systems. (auth)

35286 MAGNETIC SHELL ENHANCEMENTS DURING MAGNETIC DISTURBANCES. Willmore, A. P.; Henderson, C. L. (University Coll., London). Proc. Intern. Space Sci. Symp., 1964, 5: 241-9(1965).

Langmuir probe observations of electron density on the satellite Ariel 1 for May–July 1962 show that even on magnetically quiet days longitudinal irregularities appear, particularly near the South Atlantic anomaly. The region of locally depressed density near the shell L = 4 shows a diurnal variation of intensity, and in the southern hemisphere it inverts to an increase in density during the late morning. A minimum was observed at the magnetic equator in the evening hours, about 500 km above the peak of the equatorial anomaly. For disturbed periods enhancements have been observed with a structure resembling magnetic shells, which tend to merge and to approach lower L values as the disturbance increases. For one disturbed period strong enhancements were noted at night near the South Atlantic anomaly. These phenomena imply the influence of energetic particles on topside irregularities. (auth)

35287 DOPPLER FREQUENCY ANOMALIES OF SATELLITE SIGNALS AND UPPER IONOSPHERIC STRUCTURE. Mass, J. (Scientific Dept., Ministry of Defence, Israel). Proc. Intern. Space Sci. Symp., 1964, 5: 252-64 (1965).

Doppler frequencies on a satellite transmission on 20 Mc/s were calculated far out to the horizons. The refraction effects decreasing the total Doppler swing were taken into account using ground-based ionosonde data. A comparison with actually recorded total Doppler swings from horizon to horizon shows agreement better than 1% except at early morning hours and certain transit geometries, when the differences amount to 5% or more. The comparison of total Doppler swings eliminates several sources of error inherent in the computation of absolute values of Doppler shift as a function of time. Of the several explanations suggested for the differences, refraction in a field-aligned upper ionosphere seems most probable. This would provide a simple method to detect the existence of a field-aligned structure, with the forthcoming ionospheric satellite (S-66). (auth)

35288 PRE-SC-EFFECTS CAUSED BY ELECTRONS AND PROTONS. Keppler, E. (Max-Planck-Institut fuer Aeronomie, Institut fuer Stratosphaeren-Physik, Lindau/Harz, Ger.). Proc. Intern. Space Sci. Symp., 1964, 5: 273-80(1965).

The assumption of Axford and Reid on an acceleration of charged particles was extended and revised in some consequences. It is shown that this model may account for the observations of Pre-SC-effects caused by protons and electrons as well and for the SC-effect. (auth)

35289 MEASUREMENT OF TOTAL ENERGY FLUX OF ELECTRONS PRECIPITATING ON AURORAL ZONES. Sharp, R. D.; Evans, J. E.; Johnson, R. G.; Reagan, J. B. (Lockheed Missiles and Space Co., Research Labs., Palo Alto, Calif.). Proc. Intern. Space Sci. Symp., 1964, 5: 282-9(1965).

The energy influx of particles precipitating on the auroral zones was measured by particle detectors aboard two polar orbiting satellites. The integral energy of precipitating electrons of energy greater than 80 ev was sampled at the auroral zones at approximately 0100 and 1300 hours local time every 90 minutes throughout the period October 31–November 4, 1963. Electrons were observed precipitating over a wide region (hundreds of kilometers) on almost every transit of the northern zone and the night side transit of the southern zone. The measured flux is compared with the K-indices. A significant day-night effect was observed in the northern auroral zone; i.e., the total precipitated energy was considerably larger on the night side. Large variations in the angular and energy distributions were also observed. (auth)

35290 THE ENERGY LOSS OF SLOW PROTONS IN THE ATMOSPHERE, CRITICAL PARAMETERS AND THEIR CONNECTIONS WITH THE AURORA. Giorgi, M.; Gregori, G. P. (CENFAM, Consiglio Nazionale delle Ricerche, Rome). Proc. Intern. Space Sci. Symp., 1964, 5: 290-2 (1965).

The penetration of slow protons in the atmosphere is studied, particularly with respect to the dependence on the errors of the absorption law. The differential energy loss and the proton spiral radius as functions of altitude were evaluated. (L.B.S.)

35291 ROCKET MEASUREMENTS WITH ELECTRON AND ION PROBES IN AN AURORA. Ulwick, J. C. (Air Force Cambridge Research Labs., Bedford, Mass.); Pfister, W.; Haycock, O. C.; Baker, K. D. Proc. Intern. Space Sci. Symp., 1964, 5: 293-311(1965).

An Aerobee rocket was fired into a Class I Aurora at Churchill, Canada on February 8, 1964. Data are available from the following experiments: retarding potential probes mounted on the front and side, standing wave impedance probes on two frequencies, plasma frequency probe, plasma resonance probe and a Langmuir probe. In addition, simultaneous measurements were made with an ionosonde, all sky cameras, photometers, spectrometers, auroral radar, riometers and magnetometers. The rocket went through the aurora on ascent and decent at about 105 km. Density values were measured at this altitude about 2.5×10^5 per cm^3. This is about a factor of 10 more than that measured at the peak altitude of 228 km. The data are relatively smooth with little of the irregularities expected in an aurora. (auth)

35292 EXPERIMENTAL EVIDENCE FOR A SUDDEN HEATING OF THE IONOSPHERE IN THE AURORAL ZONE, AND ITS CORRELATION WITH OTHER GEOPHYSICAL DATA. Blamont, J. E.; Chanin-Lory, M. L. (Service d'Aeronomie du C.N.R.S., Verrieres-le-Buisson, France). Proc. Intern. Space Sci. Symp., 1964, 5: 313-17(1965).

Two neutral gas temperature measurements around 125 km made at Fort Churchill, Canada, during the twilights of May 21 and 22, 1963, are reported. One of these measurements shows a sudden increase of 600°K in 20 minutes. All available geophysical data for both nights are presented. (auth)

35293 ON THE ACCELERATION OF ELECTRONS IN THE MAGNETOSPHERE DURING MAGNETIC STORMS. Tverskoii, B. A. (Academy of Sciences, USSR). Proc. Intern. Space Sci. Symp., 1964, 5: 318-24(1965).

The possible mechanisms of electron acceleration in the magnetosphere during magnetic storms are shown. A warm-up by a non-collision born shock wave propagating perpendicularly to the field as well as electron acceleration in the ionosphere by non-linear helical waves are considered. Electrons can be warmed up to 1 to 10 kev by the first process and to 10 to 100 kev by the second one. The acceleration to energies of >300 kev is hardly provable. It is shown that the dumping of electrons accelerated in the ionosphere can lead to a strong atmosphere ionization at the altitudes of ≥300 km and to electron warm-up in this region up to 8,000 to 10,000 deg. In this case an effective ejection of ionized oxygen to the high altitudes must take place. The last process can explain the splitting of the outer radiation belt into E_1 and E_2 zones. (auth)

35294 INVESTIGATION OF THE EARTH'S RADIATION BELTS IN THE REGION OF THE BRAZILIAN MAGNETIC ANOMALY AT ALTITUDES OF 200-400 km. Vernov, S. N.; Savenko, I. A.; Shavrin, P. I.; Nesterov, V. E.; Pisarenko, N. F.; Sharvina, K. N. (Academy of Sciences, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 343-59(1965).

As a result of exploration of radiation in the region of the Brazilian magnetic anomaly on the Cosmos 4, Cosmos 7, Cosmos 9, and Cosmos 15 sputniks, the following results were obtained. During the flight of Cosmos 4 sputnik in April 1962, an approximately four-fold increase in the counting rate of the Geiger counter was detected, as compared with measurements carried out in August 1960 on the 2nd spacecraft satellite. This increase conformed to that expected, according to Hess' computation of the proton intensity change in the inner belt during the transition to the solar minimum which is accompanied by a decrease in atmospheric density. Electron lifetime in the artificial radiation belt was measured and proved to be decreasing from a value of four months, for B = 0.23 gauss and $1.25 < L < 1.4$, to 20 days, for B = 0.265 gauss and $L \sim 2$. It follows from a comparison with measurements on the Telstar satellite that electron lifetime on a magnetic shell with L = 2 does not depend on B in the interval from 0.04 to 0.265 gauss, which indicates the action in this shell of a strong loss mechanism, different from Coulomb scattering in the atmosphere (e.g., magnetic scattering). From the data of the Cosmos 7 and Cosmos 15 satellites the geographic distribution of the artificial belt electron intensity in the Brazilian anomaly was determined and proved to nearly coincide with the distribution obtained with the help of a magnetic spectrometer, as well as with radiation distribution recorded by a scintillation counter on the Discoverer 31 satellite. Experimental points with high counting rate ratio of Geiger and scintillation counters are positioned, according to the data of the second spacecraft satellite and Cosmos 15 sputnik, on magnetic shells with $L < 1.4$, which indicates a faster electron intensity decrease with L diminishing as compared with proton intensity. Thus, the geographic electron distribution in the Brazilian anomaly is likely to be somewhat different from the high-energy proton distribution. Indirect indications of the existence of electrons of energies exceeding 2 Mev in the inner radiation belt are obtained. (auth)

35295 VARIATION OF ELECTRON SPECTRUM AND INTENSITY AT LOW ALTITUDES. Imhof, W. L.; Smith, R. V. (Lockheed Missiles and Space Co., Research Labs., Palo Alto, Calif.). Proc. Intern. Space Sci. Symp., 1964, 5: 360-5(1965).

Electron fluxes and energy spectra were measured on low-altitude polar orbiting satellites in late 1962 and in 1963. The data were analyzed in terms of the changes of electron intensity and energy spectrum with the coordinates B, L, and longitude. The 1962 measurements were performed with shielded plastic scintillators having ef-

fective electron thresholds of 1.2 and 2.4 Mev. The 1963 measurements were performed with a plastic scintillation spectrometer equipped with a 16-channel pulse height analyzer operating in two energy ranges (0.3 to 2.6 Mev, and 0.3 to 10.0 Mev) and coded in binary form for the digitized telemetry of individual counts. On low L shells ($L \leq 1.7$) the electron fluxes observed at large B values are found to undergo a buildup with eastward drift until the electrons are dumped in the Brazilian anomaly. Energy spectra of these electrons are much softer than those of the trapped electrons mirroring at lower B values on the same L shell, and are consistent with their source being the preferential low energy scattering of the harder trapped electrons. This interpretation is further substantiated by the similarity of decay in intensity of the electrons at high B values and decay of the general electron population on the same L shell. (auth)

35296 ON THE NATURE OF THE EARTH'S RADIATION BELTS. Tverskoii, B. A. (Academy of Sciences, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 367-73(1965).

An equation of the dynamics of the radiation belts is obtained describing transitions of particles between the drift shells during magnetic storms, as well as ionization loss. Presuming that neutron disintegration is the source of fast particles, an intensity distribution and the energy spectrum of protons and relativistic electrons are computed. Consideration is given to 11-year variations in the outer belt connected with the change of solar proton generation intensity. The results obtained coincide with the experimental data. Significant relativistic electron intensity variations proved to be reversible. The method of determining the change of magnetic field as a function of intensity, and the contrary, is shown. The mechanism of trapping particles from interplanetary space and an evaluation of parameters of an outer proton-helium belt, thus formed, are also given. (auth)

35297 REDISTRIBUTION OF TRAPPED PROTONS DURING A MAGNETIC STORM. McIlwain, C. E. (Univ. of Calif., San Diego, La Jolla). Proc. Intern. Space Sci. Symp., 1964, 5: 374-91(1965).

The first observation of a change in the distribution of high energy geomagnetically trapped protons which can be definitely attributed to the breakdown of adiabatic motion was obtained with the aid of a scintillation detector aboard the Relay I satellite. Most of the observed variation in proton fluxes took place within a period of one day centered on 0 hours UT September 23, 1963, during the occurrence of the largest fluctuations in the earth's magnetic field in almost two years. The intensity of protons with energies greater than 34 Mev decreased by over a factor of ten in the region $L > 2.50$ earth radii and $B > 0.05$ gauss but changed by less than 10% in the region $1.80 < L < 2.10$. The character of the changes was such that previous events of this type could have produced the anomalous characteristics of the initial distribution. (auth)

35298 ON THE ASYMMETRY OF THE INTENSITY OF FAST ELECTRONS IN CONJUGATE POINTS AT LOW ALTITUDES. Vernov, S. N.; Savenko, I. A.; Tverskaya, L. V.; Tverskoii, B. A.; Shavrin, P. I. (Academy of Sciences, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 392-8(1965).

From data obtained by the 2nd and 3rd spacecraft the electron intensity distribution at points whose conjugate points are underground was studied. Two regions were discovered in which the intensity was different from the background, namely the regions conjugate with the South Atlantic and Bering negative geomagnetic anomalies. In the last case the effect was distinctly observed only on the 3rd spacecraft, whose flight took place during a strong magnetic storm. The lifetime of electrons with very small pitch-angles is considered, and the possibility of reflection of these electrons from the upper atmosphere owing to Coulomb scattering is discussed. (auth)

35299 THEORETICAL STUDIES OF PROTONS IN THE OUTER RADIATION BELT. Dungey, J. W.; Hess, W. N.; Nakada, M. P. (Goddard Space Flight Center, Greenbelt, Md.). Proc. Intern. Space Sci. Symp., 1964, 5: 399-403(1965).

The variations in the energy spectra with pitch angle and L of the relatively stable 0.1 to 5 Mev protons in the outer radiation belt were found to be in good agreement with the results of a model that permits rapid motion of the protons in L space. In this model, the protons violate the third adiabatic invariant of trapped particle motion but do not violate the first two adiabatic invariants. Changes in fluxes with L are not consistent with Liouville's Theorem. Both the departure from Liouville's Theorem and variations in energy spectra seem to indicate that the source of these protons is at large L. (auth)

35300 PRELIMINARY RESULTS OF STUDY OF RADIATION CARRIED OUT ON BOARD THE COSMOS-17 SATELLITE. Vernov, S. N.; Chudakov, A. E.; Vakulov, P. V. (and others). Proc. Intern. Space Sci. Symp., 1964, 5: 404-22(1965).

The Cosmos 17 satellite carried two (outer and inner) scintillation counters and a gas discharge counter of the STS-5 type internally. These instruments recorded electrons with energy $E \gtrsim 50$ kev and protons with energy $E \gtrsim 0.5$ Mev. As a result of analysis of the information received, data were obtained on the intensity and spatial distribution of particles of the radiation belts and cosmic rays. Data on cosmic ray intensity are analyzed from the stand-point of the value of critical energy at a given point of space. Data are also obtained concerning the intensity of electrons at the forbidden regions of space, i.e., at those drift trajectories of electrons which approach the low altitude at the region of the Atlantic anomaly. An estimate is given of lifetime of electrons in radiation belts (about one year at small L). (auth)

35301 STUDY OF THE DRASTIC CHANGES OF THE RADIATION IN THE UPPER ATMOSPHERE IN JULY, 1962. Galperin, Yu. I.; Bolyunova, A. D. (Inst. of Physics of the Atmosphere, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 446-57(1965).

The radiation effects of the high-altitude thermonuclear explosion over Johnston Island on July 9, 1962 were registered by the Cosmos-5 satellite. At the moment of the explosion a hard radiation splash was discovered far away from the zone of the burst point direct visibility. This splash, which is called γ-twilight, apparently was due to registration of γ-radiation induced by the explosion. The explosion occurred at 12h 00m 09.8s ± 1s of Moscow time (GMT + 3h). During the first minutes after the splash at the position of the Cosmos-5 satellite, positively-charged corpuscles—protons, α-particles, fission fragments or positrons were discovered, which drifted westward to meet the satellite which was moving in the direction of the burst point. Ten minutes after the burst hard electrons of several Mev became dominant. In the region magnetically conjugate to Johnston Island at the altitude ~500 km and in the vicinity of the Brazilian anomaly at heights of 200–300 km, soft electrons were discovered. Their absorption in the atmosphere obviously caused the artificial aurora above the Pacific Ocean. The maximum intensity of hard electrons was registered on July 9, an hour after the explosion, above the South Atlantic. It amounted to $\sim 2 \times 10^9$ electrons/cm^2 sec. The intensity maximum of the artificial radiation belt created by the explosion was situated at an altitude of ~1350 km above Johnston Island. This altitude changed with longitude. The artificial belt intensity decreased with time. The most pronounced diminution occurred during the first 24 hours after the explosion and then became slower and slower. During the first four months the intensity near the center of the artificial belt decreased by an order of magnitude. A sharp rise of the radiation background was discovered significantly lower in the atmosphere than the stable belt of trapped particles can exist. The rate of decrease of this intensity excess above the cosmic ray background was similar to the rate of intensity decrease in the maximum of the artificial belt. The nature of the phenomena registered is discussed briefly. (auth)

35302 INTERACTION OF TRAPPED ELECTRONS WITH THE ATMOSPHERE. Walt, M.; Newkirk, L. L. Proc. Intern. Space Sci. Symp., 1964, 5: 458-65(1965).

35303 MEASUREMENTS IN THE RADIATION BELTS FROM HITCH-HIKER I. Paolini, F. R. (American Science and Engineering, Inc., Cambridge, Mass.); Giacconi, R.; Waters, J. R.; Katz, L.; Smart, D. Proc. Intern. Space Sci. Symp., 1964, 5: 466-88(1965).

The Air Force sub-satellite Hitch-hiker I was launched into an elliptical polar orbit on July 1963. The satellite carried a payload which included six radiation detection instruments for simultaneously investigating the energy spectra and angular distributions of protons and electrons in the Earth's magnetosphere over a broad range of energies. Data from an orbit of 4 July show qualitative differences in the structures of the radiation belts defined by the different energy bands investigated. Electrons of energies greater than 4 Mev (as detected by a Geiger counter) define two distinct zones with hearts at L ~ 1.6 and L ~ 4.5, with a pronounced slot between them at L ~ 3.0. Electrons of energies between 1 and 4 Mev behave similarly. Protons of energies between 1 and 4 Mev are also found to lie in two zones, congruent with the electron zones, but with the outer one not so well pronounced. Electrons of energies between 15 and 100 kev define a single zone, extending beyond L ~ 6.9, and with a heart around L ~ 1.6. Differential spectra of electrons from 15 to 100 kev, measured with a 15% resolution, exhibit maxima around 40 kev over an extensive region of the magnetosphere, L < 4, but monotonically decrease from 15 kev in regions beyond L ~ 4. Integral spectra of electrons from 0.5 to 4 Mev differ in the two zones: those of the outer zone are very steep, those of the inner, relatively flat. Integral spectra of protons from 1 to 4 Mev are all steep, and very similar in shape. Pitch angle distributions of the outer belt (L ~ 4.3) electrons (0.5 to 4 Mev) and protons (1 to 4 Mev) are symmetric about maxima at 90°. (auth)

35304 ATLAS OF THE INTENSITY DISTRIBUTIONS OF TRAPPED CORPUSCLES MEASURED BY THE "COSMOS-3" AND "COSMOS-5" SATELLITES. Temny, V. V. (Inst. of Physics of the Atmosphere, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 489-97(1965).

The intensity distributions of trapped hard protons and electrons in the B, L coordinate system are presented, and also the mappings deduced for different heights up to 1500 km, according to Cosmos-3 and Cosmos-5 data from April 26 to July 9, 1962. The lowest intensity levels at heights up to 1500 km are situated approximately over Indonesia, and the highest near the Atlantic coast of Brazil. The data analysis from different detectors of Cosmos-3 and Cosmos-5 satellites and comparisons with other data suggest that the shape of the omnidirectional intensity distributions for protons with energy >50 Mev and electrons, in the units particles per cm^2 per sec, are markedly different. (auth)

35305 LOW-ENERGY ELECTRONS MEASURED BY THE COSMOS-3 AND COSMOS-5 SATELLITES. Mularchik, T. M.; Vaisberg, O. L. (Inst. of Physics of the Atmosphere, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 500-10(1965).

Accelerating fluorescent indicators on the Cosmos-3 and Cosmos-5 satellites registered very soft electrons, their energy being in the range of 0.04 to 5 kev. They were observed mostly on the sunlit portion of the orbit. Their mean intensity was $\sim 5 \times 10^8$ electrons per cm^2 per sec per steradian and had tendency to rise with height. Their pitch angle distribution was nearly isotropic and markedly different from such distributions for harder electrons. (auth)

35306 CORRELATION BETWEEN SOLAR X-RAY FLUX MEASURED FROM N.R.L. SR 1 SATELLITE AND IONOSPHERIC PARAMETERS. Noci, G.; Russo, D. (Osservatorio Astrofisico di Arcetri, Florence). Proc. Intern. Space Sci. Symp., 1964, 5: 517-20(1965).

Correlation coefficients between the x-ray flux in the interval 0 to 8 Å and ionospheric parameters were computed. The highest correlation coefficient was found for the E layer. For this region the ratio between the electron number due to the 0 to 8 Å x rays to the total electron number was evaluated. A variation of the spectrum shape when the x-ray flux is higher than a certain value is suggested. (auth)

35307 RESULTS FROM THE IMP-I RETARDING POTENTIAL ANALYZER. Serbu, G. P. (Goddard Space Flight Center, Greenbelt, Md.). Proc. Intern. Space Sci. Symp., 1964, 5: 564-74(1965).

Some preliminary experimental results obtained with a planar geometry retarding potential analyzer which was flown on the IMP-I satellite are presented. The plasma energy spectrum for both ions and electrons was measured in the range from 0 to 100 ev. Charged particle density measurements were obtained continuously from 1000 km to 30 earth radii. The results show a sharp decrease of about an order of magnitude in charged particle density at about 4.5 R_e, similar to the decrease deduced from whistler observations. The electrons exhibited thermal energies for geocentric distances less than 4.5 R_e. The average electron energy then increased gradually to values above 100 ev at about 8 R_e. The observed satellite potential was less than 1 volt positive. (auth)

35308 STRUCTURAL CHARACTERISTICS OF THE RADIATIVE FIELD OF THE EARTH AS A PLANET. Borisenkov, E. P.; Doronin, Y. P.; Kondratiev, K. Y. Proc. Intern. Space Sci. Symp., 1964, 5: 590-4(1965).

The results of a study of the structural characteristics of the radiative field of the earth, as determined from infrared data obtained by Tiros 2 and Tiros 3, are given. (auth)

35309 A SYNOPTIC VIEW OF IONIC CONSTITUTION ABOVE THE F-LAYER MAXIMUM. Raitt, W. J.; Laflin, Susan; Boyd, R. L. F. (University Coll., London). Proc. Intern. Space Sci. Symp., 1964, 5: 629-34(1965).

The UK–US satellite Ariel carried an ion mass spectrometer operating on the principle of analysis of arrival energy of the ions. A very large amount of data has been gathered and it is now possible to obtain a picture of the variation of the ionic composition above 400 km with latitude and longitude. A strong diurnal effect is evident together with marked geomagnetic control. There is evidence also for a seasonal variation. (auth)

35310 UPPER F-REGION PROFILES DURING LOW SOLAR ACTIVITY DERIVED FROM OBSERVATIONS ON FARADAY FADING OF SATELLITE TRANSMISSIONS. Somayajulu, Y. V.; Tyagi, Tuhi Ram; Bhatnagar, V. P. (National Physical Lab., New Delhi). Proc. Intern. Space Sci. Symp., 1964, 5: 641-51(1965).

The total electron contents measured at Delhi using the Faraday-fading of the Cosmos V transmissions during July–October 1962, a period of low solar activity, are utilized to derive the upper F-region profiles. The results show that during daytime the transition from O^+ to He^+ occurs around 600 km'. At night the measured electron contents are consistent with those derived from the profiles if the transition from O^+ to H^+ occurs around 550 km'. These transition altitudes are lower than those predicted by theory. This is explained to be due to a higher proportion of the lighter ion. One of the consequences of low transition altitudes is that the ratio of the electron contents above and below peak for low solar activity are higher than that for high solar activity, in agreement with the results previously reported. (auth)

35311 IONOSPHERIC ELECTRON CONTENT MEASUREMENTS IN REGIONS OF LOW MAGNETIC DIP AND THROUGH THE BRAZILIAN MAGNETIC ANOMALY. De Mendonca, F. (Comissao Nacional de Atividades Espaciais, São Paulo, Brazil). Proc. Intern. Space Sci. Symp., 1964, 5: 687-701(1965).

Differential Doppler measurements made with harmonically related frequencies transmitted from satellites

are utilized for calculation of the latitudinal and diurnal variations of the total electron content of the ionosphere. These preliminary measurements, performed during April and May, 1963, with the satellite Anna 1-B, cover areas with subionospheric points from the vicinity of the magnetic equator to about −40° dip, and between longitudes of 35° and 60° W. Mainly two distinct phenomena are noticed in the ionosphere of this region. The first is that a latitudinal maximum value of the total electron content develops at the magnetic equator at sunrise and moves way toward higher dip angles for the whole day, possibly due in part to diffusion in the higher ionosphere along the magnetic field lines. The second phenomenon is that there is a marked increase in electron content in the region which geographically corresponds to the area of the Brazilian anomaly of the earth's magnetic field in the South Atlantic. This enhancement in electron content is attributable to ionization caused mostly by high energy particles of the artificial belt, which have mirroring points in levels well into the ionosphere at the magnetic anomaly. (auth)

35312 ELECTRON DENSITY MEASUREMENTS IN THE IONOSPHERE OVER THE SAHARA WITH A VARIABLE FREQUENCY IMPEDANCE PROBE. Jacobs, K. G.; Rawer, K. (Ionosphaeren-Institut, Breisach, Ger.). Proc. Intern. Space Sci. Symp., 1964, 5: 706-18(1965).

An approximate replacing network for an antenna in a homogeneous magnetized plasma is established and the characteristic frequencies are computed. In a real network with parallel and serial capacitors four resonance frequencies should appear, two below and two above the gyro-frequency. A variable-frequency impedance-probe is described and results of a first rocket flight are given. The main geophysical result concerns the valley between E- and F-regions. There was (in the afternoon) a clear minimum at 130 km, the corresponding electron density being only 50% of that of the normal E-layer at 110 km. Incoherent data were found near the peak of the orbit; these are attributed either to a failure of the approximate theory for a transverse magnetic field, or to local influences of rocket outgassing at subsonic speed. (auth)

35313 THE TECHNIQUE AND RESULTS OF EXPERIMENTS CONDUCTED ON THE COSMOS 2 SATELLITE BY MEANS OF LANGMUIR PROBES AND ION TRAPS OF THE HONEYCOMB TYPE. Gringauz, K. I.; Gorozhankin, B. N.; Gdalevich, G. L.; Afonin, V. V.; Rybchinskii, R. E.; Schutte, N. M. (Academy of Sciences, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 733-50(1965).

A description is given of some sensitive elements used in experiments aboard Cosmos 2 satellite. The technique of measurements in the ionosphere of electron density and temperature by means of cylindrical Langmuir probes, and of ion temperature by means of honeycomb ion traps is outlined. As an example some results are given of measurements of these parameters made in the height region from 220 km to 550 km. Considerations are presented concerning the influence of geomagnetic field on electron density measurements. Prospects of the use of the technique of ionospheric investigation described are briefly discussed. (auth)

35314 ATMOSPHERIC SCALE HEIGHT IN THE 200-400 km RANGE ACCORDING TO RADIATION BELT DATA. Galperin, Yu. I.; Temny, V. V. (Inst. of Physics of the Atmosphere, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 769-78(1965).

According to present views on the thermal energy balance of the upper atmosphere at low latitudes, the mean night flux of particles precipitating from the radiation belt is insignificant ($<3 \times 10^{-2}$ erg/cm^2 sec) in comparison to diurnal mean solar ultraviolet flux. The most intense energy absorption of radiation belt particles at low latitudes apparently occurs in the region of the Brazilian (or South Atlantic) anomaly. The atmospheric parameters deduced from satellite deceleration are relatively insensitive to such local effects in comparison to regular solar time variations. Scale height determinations in this particular region may be obtained from measurements of the height dependence of the intensity of trapped hard protons. Precise computations of the upper atmospheric parameters from the radiation belt data cannot be made at present because of uncertainty in the hard protons' trajectories in the region of the Brazilian anomaly. But some valuable estimates are made from hard radiation measurements on the Cosmos-3 and Cosmos-5 satellites in the summer of 1962. The scale height value is around 60 km for mean height ~300 km from the measured height-intensity dependence of protons with energy >50 Mev. Comparison with the Explorer 4 measurements in 1958 shows that during this period the scale height value diminished by 1.27 ± 0.05 times. The estimation is made of the scale height at high altitudes from the East-West asymmetry of the proton flux. Comparison with other data on global mean atmospheric parameters, and with direct measurements of trapped particles at low altitudes over the Brazilian anomaly made by other instruments on Cosmos-3 and Cosmos-5 satellites, shows that the additional thermal flux in this region from precipitation of the trapped particles is hardly significant. (auth)

35315 ON THE MECHANISM OF PRODUCTION OF METASTABLE ORTHOHELIUM ATOMS IN THE UPPER ATMOSPHERE. Krassovskii, V. I.; Shefov, N. N. (Inst. of Physics of the Atmosphere, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 822-5(1965).

On the basis of an analysis of data on photoelectrons, obtained by the satellites Cosmos 3 and Cosmos 5, and the emissions in different aurorae, the assumption is made that during the aurora the concentration of metastable fluorescent orthohelium atoms may increase not only due to secondary electrons under corpuscular bombardment, but also due to direct intrusion of electrons with an energy of a few tens of ev. (auth)

35316 MAGNETIC INVESTIGATIONS ON THE ELECTRON 2 SATELLITE. Eroshenko, E. G.; Dolginov, Sh. Sh.; Zhuzgov, L. N.; Fastovskii, U. V.; Alexanyan, L. M. (Academy of Sciences, Moscow). Proc. Intern. Space Sci. Symp., 1964, 5: 980-4(1965).

Magnetic measurements were made from the Electron 2 satellite, launched on January 30, 1964. The apogee of the orbit is 11.6 R_E (R_E is the Earth radius), the inclination to the equator is 61°. Two flux-gate magnetometers were used. The first device has a measurement range of ±120 gammas, the second of 1200 gammas. The corresponding sensitivity is 2 and 20 gammas. Measurements are made every 2 or 8 minutes. All the channels of the magnetometers are hourly calibrated by the sample field. On the ascending parts of the orbits at distances smaller than 5.5 R_E and on the descending parts at distances smaller than 7 R_E the field is smaller by 0−120 gammas than the calculated one. At distances larger than the above mentioned the field is larger up to 25 gammas than the calculated one during a quiet day and up to 70 gammas larger on a disturbed day. The effect of the outer sources of the field in the outer zone of radiation is found within a range of longitudes of 160°, which proves the circular character of the sources. The results agree with the measurements made by Lunik 2 (1959) and Explorer 10 (1961). (auth)

35317 SOME EVIDENCES OF THE PARTICLE EFFECTS ON THE IONOSPHERE AT MIDDLE LATITUDES. Hirao, K.; Wakai, N.; Sawada, K.; Hikosaka, T.; Yano, K.; Maeda, K. Proc. Intern. Space. Sci. Symp., 1964, 5: 1058-70(1965).

Although the ionosphere is mainly maintained by the solar radiation of ultraviolet as well as soft x-ray components, another source of ionization can be considered from the results of analysis of the night-E layer, propagation of electromagnetic waves in middle latitude zone, the airglow component of the first negative band of the nitrogen molecule and the electron temperature distribution observed with rockets. The electron density of the night-E layer observed by the ionosonde shows a good correlation with geomagnetic activity. The short waves propagating through the ionosphere at middle latitudes at nighttime are attenuated also in the magnetically disturbed period.

The negative band in the airglow can be almost always observed and also becomes strong during the magnetically disturbed time. The electron temperature in the ionosphere is high at the high latitude region in quiet conditions. It becomes much higher than usual at a rather low latitude region also in the period of disturbance. These results are reasonably explained by considering the particle penetration into the ionosphere. (auth)

35318 ROCKET OBSERVATION OF THE IONOSPHERE BY USING THE VLF DOPPLER TECHNIQUE. Maeda, K.; Obayashi, T.; Kimura, I. (Kyoto Univ.). Proc. Intern. Space Sci. Symp., 1964, 5: 1071-9(1965).

The NDT signal, 17.44 kc/s, was measured by the Japanese rocket L-2-2, which was launched at 1400 J.S.T. on December 11, 1963 at Kagoshima Space Center (K.S.C.) for investigating the electron density profile of the ionosphere by the radio Doppler technique. The rocket reached 400 km altitude and the observation was satisfactory. The Doppler beat signal was continuously recorded on a pen oscillograph during the entire flight-time whenever the NDT signal was transmitted. The maximum plasma frequency, equivalent to the critical frequency f_0F_2, deduced from the record was about 6.8 Mc/s for the ascending path and 8.9 Mc/s for the descending path, while the value of f_0F_2 observed at K.S.C. by the vertical incidence ionosonde was 6.2 Mc/s. The above discrepancy is attributable to the latitude difference of the observing point, because the f_0F_2 at ascent was observed at a point about 100 km southeast of K.S.C. and at descent was observed about 500 km southeast of K.S.C. The electron-density profile obtained by the rocket observation is compared with that of ionosonde data. (auth)

35319 CORPUSCULAR AND PROTON CLOUD FROM FLARE AS A POSSIBLE SOURCE OF RADIO EMISSION IN cm TO km RANGE. Krivsky, L. (Astronomical Inst., Ondrejov, Czechoslovakia). Proc. Intern. Space Sci. Symp., 1964, 5: 1081-4(1965).

Intensive outbursts of radio emission in the cm, dm, m, and decameter range have been registered a few hours after the disappearance of several important chromospheric flares. Coincidentally with this post-flare emission the atmospherics 27 kc/s show clearly an enhanced noise level (example from 1963, Sept. 16). This radio emission complex can be emitted by the outer corona during the penetration of corpuscular cloud, by the interaction of particles of the clouds with the hypothetical magnetosphere of the sun, by the external parts of the clouds already in interplanetary space, and by the interaction of the proton cloud with the terrestrial magnetosphere and particles of the radiation belts. Proton and vlf-measurements on the satellites would determine whether this radio phenomenon took place during the penetration by the protons of the terrestrial magnetosphere, or whether it occurred before the arrival of the relatively slow solar corpuscular cloud. (auth)

35320 PATTERNS OF POLAR CAP BLACKOUTS DRAWN IN GEOMAGNETIC COORDINATES CORRECTED BY THE HIGHER TERMS OF SPHERICAL HARMONIC DEVELOPMENT. Hakura, Yukio (Radio Research Labs., Tokyo). Rept. Ionosphere Space Res. Japan, 18: 345-65 (1964).

For some 100 ionospheric sounding stations of higher latitudes, corrected geomagnetic coordinates are calculated using Hultqvist's perturbation vectors which give the displacement of "landing points" of the geomagnetic field lines. Four spherical harmonic terms following the dipole term are taken into account in the analysis of the geomagnetic field. The coordinates are utilized for the analysis of two typical polar blackouts which appeared on February 10–12, 1958, and May 6–8, 1960. The oval patterns of well developed polar cap blackouts in centered dipole coordinates are transformed into completely circular forms in the new system, giving unified cut-off latitudes for PCA-producing solar cosmic rays. The unified cut-off latitude of the polar cap blackout coincides closely with the latitudinal distribution of solar cosmic ray flux obtained by satellites. The coordinates are useful for quantitative analyses of ionospheric phenomena which are related to the motion of charged particles in the geomagnetic field. (auth)

35321 ABSOLUTE PHOTOMETRY OF ALL SKY CAMERA PHOTOGRAPHS OF THE AURORA USING TWILIGHT BRIGHTNESS. Kaneda, Eisuke; Ogawa, Toshihiro; Tohmatsu, Takao (Tokyo Univ.). Rept. Ionosphere Space Res. Japan, 18: 450-5(1964).

A series of observations of the twilight sky at the zenith were made with a photometer, having an objective aperture of 41 mm and a double field angle of 3.1°. Lights through six filters are detected in turn with a 1P21 photomultiplier. Mean twilight curves are obtained from six observations each of the morning and evening twilights. Bluing in early stages is thought due to multiple scattering of sunlight, bluing in later stages is due to oxygen airglow bands. The green color indicates the 5577 Å radiation of atomic oxygen. Absolute brightness spectra for the colors are given. (J.F.P.)

Low Temperature Physics

Refer also to abstract 34324.

35322 QUANTUM-STATISTICAL THEORY OF SPIN ECHO IN LIQUID He^3. Ueda, Seizo (Tokyo Univ.). J. Phys. Soc. Japan, 20: 699-709(May 1965).

Quantum-statistical mechanics is applied to the spin echo method for liquid ^3He in order, first, to derive quantum theoretically the expressions for the amplitudes, or the heights of peaks, of the echo signals and, secondly, to obtain the expression for the so-called "self-diffusion coefficient" measured by this method in terms of microscopic quantities of the system. Three cases are considered: the case of a 90-180° pulse sequence, a 90-180-180° pulse sequence and the "B Method" by Carr and Purcell. It is found, among others, that the ratio of the amplitudes of two echoes in the second case is precisely expressed by the formula which has been obtained by several authors from classical or macroscopic standpoint, only with the spin diffusion coefficient D_s, of which the microscopic expression is given by Fukuda and Kubo, and also by Kadanoff and Martin, for the "self-diffusion coefficient," under a usual experimental condition. (auth)

35323 SHAPE RESONANCES IN SUPERCONDUCTING CYLINDERS. Thompson, Colin J. (Univ. of New South Wales, Kensington, Australia). Phys. Chem. Solids, 26: 1053-60(June 1965).

The energy gap equation for a superconducting circular cylinder at zero temperature was solved numerically for diameters in the range 10 to 17 au. As for the uniform membrane, the energy gap shows pronounced resonances when considered as a function of size. The resonances occurred each time an eigenvalue for motion perpendicular to the cylinder axis passed through the Fermi surface. The peaks of the resonances ($\Delta \approx 30°K$) lay well above the bulk value for the energy gap ($\Delta \approx 7°K$), and the troughs below this value ($\Delta \approx 10^{-2}°K$). The peaks were very sharp and, for most values of the diameter, the energy gap was small ($\approx 10^{-2}°K$), and showed a tendency to remain small. (auth)

35324 COMPARATIVE MEASUREMENTS OF 50 c/s LOSSES IN SUPERCONDUCTORS. Pech, T.; Duflot, J. P.; Fournet, G. (Laboratoire Central des Industries Electriques, Fontenay-aux-Roses, France). Phys. Letters, 16: 201-2(June 1, 1965).

Two procedures for obtaining measurements of 50 c/s losses in superconductors are presented. Results taken from the calorimetric and electrical procedures are compared and found to be in agreement. A Nb-25% Zr wire was investigated. (M.O.W.)

35325 THE EXISTENCE OF THE SUPERCONDUCTING STATE IN SEMICONDUCTING PbTe COMPOUNDS.

Lalevic, B. (Franklin Inst., Philadelphia). Phys. Letters, 16: 206-7(June 1, 1965).

Superconductivity in PbTe semiconductors is investigated. The measurements were performed on the following samples: PbTe + ≷0.1 wt % Pb; PbTe + 0.1, 0.5 and 1 wt % Pb (all n-type) and PbTe + 0.1 wt % Tl (p-type) (where 0.1% Tl gives the maximum charge carrier concentration for Tl doping). The superconducting transition temperatures for the samples in which superconductivity was established are listed. (M.O.W.)

35326 STABILITY AGAINST FLUX JUMPING IN SINTERED Nb_3Sn. Hancox, R. (United Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.). Phys. Letters, 16: 208-9(June 1, 1965).

It was previously shown that cylinders of sintered Nb_3Sn can be stable against flux jumping for field changes up to 50 kg. This stability was attributed to the high porosity of the specimens ($\rho \sim 4.5$ g(cm^3)) which allowed efficient cooling by liquid helium. This suggestion is considered in more detail, and experimental evidence presented to show the importance of absorption of liquid helium by sintered Nb_3Sn. (M.O.W.)

35327 ON THE POSSIBLE SIGNIFICANCE OF RELATIVE ANGULAR MOMENTUM PAIRING IN SUPERCONDUCTORS. Rothwarf, A. (RCA Labs., Princeton, N. J.). Phys. Letters, 16: 217-18(June 1, 1965).

Earlier studies have indicated the possibility of Cooper pairs being formed in relative angular momentum states. Consequences which might follow if the pairs had a finite angular momentum are considered. (M.O.W.)

35328 ANGULAR DEPENDENCE OF THE UPPER CRITICAL FIELD OF TYPE II SUPERCONDUCTORS; THEORY. Saint-James, D. (Centre d'Etudes Nucleaires, Saclay, France). Phys. Letters, 16: 218-20 (June 1, 1965).

Two cases of angular dependence are investigated. A constant field is imposed parallel to the slab and equal to the nucleation field H||. When the sample is tilted by an angle θ, the temperature has to be modified to restore the nucleation. A constant temperature is imposed, the nucleation field H|| is applied, and the slab is tilted at an angle θ. The field has to be modified to restore the nucleation. An investigation for $\theta = 0$ is included. (M.O.W.)

35329 ANGULAR DEPENDENCE OF THE UPPER CRITICAL FIELD OF TYPE II SUPERCONDUCTORS; EXPERIMENTS. Burger, J. P.; Deutscher, G.; Guyon, E.; Martinet, A. (Service de Physique des Solides, Orsay, France). Phys. Letters, 16: 220-1(June 1, 1965).

Measurements of the upper critical field around the parallel orientation, covering all situations between the surface nucleation and the volume nucleation are included. Measurements were taken, using a tunneling technique, on $Al-Al_2O_3-SnIn$ 6% at. junctions. (M.O.W.)

35330 SUPERCONDUCTING TRANSITION TEMPERATURES OF SUPERPOSED FILMS. Silvert, W. (Brown Univ., Providence and Michigan State Univ., East Lansing). Phys. Letters, 16: 238-40(June 1, 1965).

The use of trial energy gap functions provides rigorous lower bounds to the critical temperature. Approximate solutions are sought for cases in which it is not possible to evaluate the energy gap function. A lower bound to the critical temperature is given by the vanishing of the difference between the thermodynamic potentials of the superconducting and normal states, expressed as a functional of an arbitrary $\Delta(\gamma)$. This calculation is carried out for two simple trial functions. (M.O.W.)

35331 POTENTIAL DIFFERENCES IN THE MIXED STATE OF TYPE II SUPERCONDUCTORS. Josephson, B. D. (Cambridge Univ., Eng.). Phys. Letters, 16: 242-3(June 1, 1965).

A general expression for the potential differences present in the mixed state is obtained. It is shown that potential differences in the mixed state are related to the motion of flux lines in just the same way as if they were due to induced emf's. The method of treatment is an extension of that used previously to interpret the results of tube magnetization experiments. Using this method, as applied to thin film bridges, the formula derived by Anderson and Dayem (Phys. Rev. Letters 13: 195(1964)) is obtained. (M.O.W.)

35332 SUPERCONDUCTIVITY IN TRANSITION ELEMENTS. Radhakrishnan, V. (Tata Inst. of Fundamental Research, Bombay). Phys. Letters, 16: 247-8 (June 1, 1965).

An investigation of the role of the Coulomb interaction alone in bringing about the superconductivity of transition elements is presented. It is shown that the attractive interaction between the s-electrons can be interpreted as arising due to the virtual exchange of acoustic plasmons, and elementary excitation introduced previously. This leads to observations about the behavior of T_c, and the corresponding variation in γ, the coefficient in the electronic specific heat. (M.O.W.)

35333 ELECTRODYNAMICS OF TYPE II SUPERCONDUCTORS. Rajput, J. S.; Gupta, A. K. (Allahabad Univ., India). Phys. Letters, 17: 81(July 1, 1965).

The modified London equation for type II superconductors is derived. The hydrodynamic description is used, and the Lorentz force and an internal force due to the gradient of the order parameter are considered. (J.F.P.)

35334 AN INTRINSIC HYSTERESIS IN TYPE II SUPERCONDUCTORS. Cardona, M.; Gittleman, J.; Rosenblum, B. (RCA Labs., Princeton, N. J.). Phys. Letters, 17: 92-3(July 1, 1965).

Polycrystalline thin plates, which formed on wall of a microwave cavity, were studied for hysteretic effects. These effects are believed to be inherent in the ideal type II superconductor. It was found experimentally that such hysteresis loops could be traced out. Other related effects are also noted and explained. (J.F.P.)

35335 TEMPERATURE DEPENDENCE OF RF RESIDUAL LOSSES IN SUPERCONDUCTORS. Haden, C. R.; Hartwig, W. H. (Univ. of Texas, Austin). Phys. Letters, 17: 106-7(July 1, 1965).

Radio-frequency flux-trapping is shown to occur to some extent in type I as well as in type II materials and can be accounted for by a simple model for trapping centers in the surface. The investigation of flux-trapping was carried out through the use of high-Q superconducting resonant circuits at frequencies near 100 Mc. This method is quite sensitive because of the high Q, or quality factor, which is of the order of 10^6 to 10^8, and makes possible the measurement of low losses due to the flux-trapping. The experimental evidence firmly indicates that the loss is flux-trapping, thus the predicted temperature dependence may be safely applied to data. (J.F.P.)

35336 NEW THERMODYNAMIC POTENTIAL EFFECTS IN HELIUM II. Donnelly, R. J. (Univ. of Chicago). Phys. Letters, 17: 109-10(July 1, 1965).

It is shown that a number of effects may be observed between two baths of liquid helium II connected by a narrow channel, such as the saturated film, through which only the superfluid can pass. These effects are investigated experimentally and theoretically with satisfactory agreement in the results. (J.F.P.)

35337 TEMPERATURE AND FREQUENCY DEPENDENCE OF ULTRASONIC ABSORPTION IN LIQUID HELIUM BELOW 1°K. Jeffers, W. A., Jr. (Massachusetts Inst. of Tech., Cambridge, Mass.); Whitney, W. M. Phys. Rev., 139: 1082-96(Aug. 16, 1965).

From measurements of the temperature dependence of the amplitude of ultrasonic pulses propagated over a fixed path in liquid helium, the attenuation coefficient was determined at the six frequencies 1.00, 2.02, 3.91, 6.08, 10.2, and 11.7 Mc, at temperatures extending down to 0.2°K. Below 0.6°K, the observed variation of the absorption coefficient α(cm^{-1}) with frequency f(Mc/sec) and temperature T(°K) can be represented by the empirical equation $\alpha = 0.11 f^{\frac{1}{2}} T^3$. This

behavior differs from that predicted by several existing theories that are based upon the three-phonon or four-phonon interaction between longitudinal acoustic quanta and thermal phonons. Over the temperature interval 0.6–0.8°K, the measured attenuation is somewhat greater than would be expected from an extrapolation of the results below 0.6°K into this temperature region. A comparison of the data with some calculations by Khalatnikov suggests that the additional absorption arises from thermal conduction in the normal fluid. An equation that is analogous to the classical Kirchhoff expression adequately accounts for this contribution to the total absorption, even at temperatures for which the lifetime of the thermal phonons exceeds the period of the sound wave. (auth)

35338 FLUX-FLOW RESISTANCE IN TYPE-II SUPERCONDUCTORS. Kim, Y. B.; Hempstead, C. F.; Strnad, A. R. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 139: 1163-72(Aug. 16, 1965).

Electric resistance of type-II superconductors measured by a d-c method is related to the motion of Abrikosov vortices. Flux lines in the mixed state are driven into a viscous-flow state by increasing the Lorentz force $J \times H$ beyond the depinning threshold; the voltage observed under this condition is linear in current and the slope $\Delta V/\Delta I$ is interpreted to represent the flow rate. At low temperatures, the flow resistivity ρ_f so measured follows an empirical relation $\rho_f/\rho_n = H/H_{c2}$, where ρ_n is the normal-state resistivity and H_{c2} the upper critical field predicted by the Ginsburg-Landau-Abrikosov-Gor'kov (GLAG) theory. In high-field superconductors the GLAG upper critical fields are not accessible for conventional measurements since the paramagnetic spin alignment quenches superconductivity at much lower fields, but the above empirical rule still holds and makes it possible to determine the GLAG upper critical fields from the flow-resistivity measurements. The empirical relation also suggests that the frictional drag on a moving flux line arises from normal currents flowing in the core of the vortex line. The observed damping is, however, much larger than can be accounted for by eddy currents induced by the moving magnetic field of the vortex line. Two new mechanisms, one proposed by Tinkham and another by Stephen and Bardeen, appear to correct this difficulty and they are discussed in the text. Also reported is a new type of resistance-minimum phenomenon: if the temperature T is increased from zero at a fixed field H, the resistance R(T) of a type-II specimen decreases initially and goes through a minimum before it reaches the normal resistance at $T_c(H)$. This behavior is qualitatively accounted for by including the dissipation outside of the vortex core. (auth)

35339 INTERNAL CURRENTS AND MAGNETIC FIELDS CLOSE TO THE SURFACE FOR A TYPE-II SUPERCONDUCTOR FOR APPLIED MAGNETIC FIELDS NEAR THE UPPER CRITICAL FIELD H_{c2}. Fink, H. J. (Atomics International, Canoga Park, Calif.). Phys. Rev. Letters, 14: 853-7(May 24, 1965).

Based on the Ginzburg-Landau theory of superconductivity, the shielding currents and the internal magnetic field were calculated as a function of distance from the surface for type-II superconductors when the applied magnetic field is near the upper critical field. (J.F.P.)

35340 SPECIFIC HEAT OF He^3 AND He^4 IN THE NEIGHBORHOOD OF THEIR CRITICAL POINTS. Mcldover, M. R.; Little, W. A. (Stanford Univ., Calif.). Phys. Rev. Letters, 15: 54-6(July 12, 1965).

The question of whether for a real gas the specific heat behaves in a manner similar to that of a lattice gas is investigated. A study is made of the specific heat at constant volume of both helium-3 and helium-4 at densities close to the critical density. The results confirm the view that quantum effects would reduce the magnitude of the singular contribution to the specific heat in helium. (J.F.P.)

35341 THE EFFECT OF EXCHANGE-COUPLED MAGNETIC IONS ON SUPERCONDUCTIVITY. Vonsovskii, S. V. (Academy of Sciences of the USSR, Sverdlovsk); Svirskii, M. S. Phys. Status Solidi, 10: No. 1, 113-119(July 1, 1965).

The conduction-electron interaction induced by virtual excitations of exchange-coupled magnetic ion pairs is considered. The dependence of the induced interaction on electron pair and ion pair states is investigated and its influence on superconductivity is discussed. (auth)

35342 DEVICES FOR STUDYING NUCLEAR MAGNETIC RELAXATION AT 0.3°K. Korepanov, V. D.; Chernitsyn, A. I.; Shvets, A. D. (Kazan State Univ. and Inst. of Physics and Tech., Kharkov). Pribory i Tekhn. Eksperim., No. 3, 139-41(May-June 1965). (In Russian)

Apparatus for the investigation of NMR in solid, liquid, and gaseous substances at temperature to 0.3°K is described. A detailed description of the metallic cryostat and the method for obtaining the low temperatures is given. Nuclear magnetic resonance is studied by the pulse method (free-precession and spin-echo signals). (tr-auth)

35343 MEASUREMENTS OF LIQUID HYDROGEN REFRACTIVE INDEX. Belonogov, A. V.; Gorbunkov, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 3, 188-93(May-June 1965). (In Russian)

The optical and cryogenic systems of a device for measuring the refractive index of liquid H in the temperature range 20 to 31°K are described. The deduction of the basic formula for calculating the value of n is given. An analysis of the measurement accuracy is carried out. Results are presented of measurements of n for ortho and parahydrogen for three long waves. (tr-auth)

35344 CRITICAL FIELDS AND FLUX PENETRATION PATTERN IN ANISOTROPIC TYPE II SUPERCONDUCTORS. Tilley, D. R. (Mullard Research Labs., Redhill, Surrey, Eng.). Proc. Phys. Soc. (London), 85: 1177-84(June 1965).

Calculations are presented of the upper critical field H_{c2}, the surface nucleation field H_{c3}, the slope of the magnetization curve and the free energy near H_{c2} and the lower critical field H_{c1}. The free energy of the vortex lattice in which the flux penetrates a bulk type II superconductor depends on the orientation of the lattice relative to the principal axes of the Ginzburg effective mass tensor. The explicit form of this orientation effect is given only for a mass tensor with nearly equal principal values. The remaining results can be summarized in the statement that the parameter κ is anisotropic. (auth)

35345 SPECIFIC HEAT ANOMALY OF Nb_3Sn AT THE NORMAL-SUPERCONDUCTING TRANSITION. Cheng, Guo-kuang; Liu, Ti-hang; Kuan, Wei-yen (Academia Sinica, Peking). Wu Li Hsueh Pao, 21: 817-23(Apr. 1965). (In Chinese)

The heat capacity of Nb_3Sn was measured between 16.0 and 20.3°K. A jump in specific heat at T_c is found with $\Delta C = 2.21$ (±5%) joule/mole deg. The transition temperature of the sample is $T_c = 17.88$°K, and the transition interval is $\Delta T_c \approx 0.2$°K. From the measured ΔC and by using the thermodynamic relation, the thermodynamic critical magnetic field at 0°K, $H_0 \approx 5300$ gauss, was obtained. Using the result for ΔC obtained in the present work and the jump of the thermo-expansion coefficient $\Delta\alpha$ and $\partial T_c/\partial p$ from the literature, the thermodynamic relation between these quantities was found to be valid. Apparatus for measuring the specific heat is briefly described. (auth)

35346 SUPERCONDUCTING MAGNET UTILIZING SUPERCONDUCTIVE SHIELDING AT LEAD JUNCTIONS. Kunzler, John E. (to Bell Telephone Labs.). U. S. Patent 3,187,229. June 1, 1965. Filed Nov. 1, 1961.

A superconducting device includes two superconducting members suspended in a low temperature environment and a solder contact between the members, and at least one of the members consists of one or more convolutions about a substantially common axis. The contact is shielded by an electrically closed superconducting magnetic shielding

member having a cylindrical configuration and consisting of one or more turns of the superconducting material encircling the contact. (B.L.M.)

Neutron Physics

See also REACTOR TECHNOLOGY — Criticality Studies.

Refer also to abstracts 35496 and 35719.

35347 (AE-184) ENERGY-DEPENDENT REMOVAL CROSS SECTIONS IN FAST NEUTRON SHEILDING THEORY. Groenroos, H. (Aktiebolaget Atomenergi, Stockholm (Sweden)). May 1965. 75p. Dep.(mn).

The analytical approximation behind the energy dependent removal cross section concept of Spinney is investigated and its predictions compared with exact values calculated by Case's singular integral method. The exact values are obtained in plane infinite geometry for the two absorption ratios $\Sigma_a/\Sigma_t = 0.1$ and $\Sigma_a/\Sigma_t = 0.7$ over a range of 20 mfp and for varying degrees of forward anisotropy in elastic scattering. The latter is characterized by choosing a suitable general scattering function. It is shown that Spinney's original definition follows if Grosjean's formalism, i.e., the matching of moments, is applied. The prediction of the neutron flux is remarkably accurate, and mostly within 50% for the spatial range and cases investigated. A definition of the removal cross sections based on matching the exact asymptotic solution to the exponential part of the approximate solution is found to give less accurate flux values than Spinney's model. A third way to define a removal cross section independent of the spatial coordinates is the variational method. The possible uses of this technique are briefly commented upon. (auth)

35348 (GA-5968) MUSE—A COMPUTER CODE FOR MULTIPLE SCATTERING-CORRECTIONS. Honeck, H. C. (General Atomic, San Diego, Calif.). Oct. 1, 1964. Contract AT(04-3)-167. 69p. Dep.(mn); $2.00(cy), 2(mn) CFSTI.

This report describes the theory and operation of the codes MUSE1 and MUSE2, designed to compute multiple scattering corrections for experiments measuring the angular cross section $\sigma_s(E,\theta)$ and the scattering kernel $\sigma_s(E' \rightarrow E,\theta)$, respectively. (auth)

35349 (ORNL-TM-1156) FAST-NEUTRON SCATTERING FROM SMALL CYLINDERS OF STEEL, ALUMINUM, AND GRAPHITE (thesis). Courtney, John C. (Oak Ridge National Lab., Tenn.). July 1965. Contract W-7405-eng-26. 104p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

Submitted to Catholic Univ. of America, Washington, D. C.

Time-of-flight methods were used to measure the spectra of fast neutrons scattered at angles of 20, 45, 70, 110, and 160 deg from the incident beam by small (2-in.-diam., 2.5-in.-high) cylinders of steel, aluminum, and graphite. The measurements were made at the General Atomic Electron Linear Accelerator (LINAC), where a pulsed source of bremsstrahlung-produced neutrons was obtained by irradiating a lead target with 14-nsec bursts of 34-Mev electrons. The energy spectrum of the neutrons approximated a fission spectrum. Some of the neutrons struck the scattering sample, which was placed 13 in. from the source, passed through a system of collimators, down a drift tube, and into a liquid scintillator fast-neutron detector. Pulse-shape discrimination circuitry was used to eliminate pulses due to any gamma-ray background. Measured source spectra were used as input for Monte Carlo calculations of the scattered neutrons, and the results were compared with measured scattered spectral intensities. The calculations and experiments, integrated over energy, agreed within 16%. (auth)

35350 (TID-21038) MODIFIED SPHERICAL HARMONIC APPROXIMATIONS. Dudley, T. E. (Knolls Atomic Power Lab., Schenectady, N. Y.); Daitch, P. B. (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science). [1957]. Contract AT(30-3)-328. 14p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The amount by which the monoenergetic, static P-L approximation solution fails to satisfy the exact transport equation is considered. This remainder is manipulated by adding terms to the ordinary P-L solution; in particular terms may be added to greatly improve the asymptotic diffusion length and its variation with c. Extrapolation lengths may be similarly improved. These modified P-L approximations are not necessarily more difficult to solve than the usual P-L approximations. It is suggested that a low order approximation may be modified to handle certain problems such as deep penetration rather than simply increasing the order of approximation. The same type of manipulation may be applied to other approximations. (auth)

35351 (TID-21851) THE MEASUREMENT OF NEUTRON DIFFUSION PARAMETERS IN HEAVY AND LIGHT WATER CONCENTRATIONS BY THE PULSED NEUTRON TECHNIQUE (thesis). Jones, Harold Gwen (Virginia Polytechnic Inst., Blacksburg. Dept. of Physics). June 1965. Contract AT(40-1)-2686. 59p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Neutron diffusion parameter measurements have been made at 21°C in 0, 20, 50, 80, and 100 percent concentrations of heavy and light water. Pulsed neutron techniques were used with a 250-kv Cockcroft-Walton accelerator as the pulsed source. The range of bucklings used was from 0.05 to 0.70 cm^{-2}. The values for the diffusion coefficient, D_0; the diffusion cooling coefficient, C; and the transport mean free path, λ were determined from the expansion of the decay constant to second order using an iteration procedure. The values of D_0, C, and λ are tabulated. (auth)

35352 (TIM-792) USE OF DSN CODE FOR NEUTRON SHIELDING CALCULATIONS. Larson, A. R. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Aircraft Nuclear Engine Lab.). Dec. 27, 1963. Contract AT(11-1)-229. 8p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The Los Alamos DSN Code was applied to the calculation of the neutron attenuation kernel for a point fission source in hydrogen. Excellent results were obtained when use was made of the anisotropic option, n equal to 16 in the S_n approximation and a set of cross sections having a fine group structure between 0.1 and 14 Mev. The broad group structure in the high-energy range of 16-group cross sections used for reactor calculations was shown to be inadequate. (auth)

35353 MEASUREMENT OF THE SLOWING-DOWN AND THERMALIZATION TIME OF NEUTRONS IN WATER. Moeller, E.; Sjoestrand, N. G. Arkiv Fysik, 27: 501-30 (1965).

The experimental equipment for the study of the time behavior of neutrons during slowing-down and thermalization in a moderator by the use of a pulsed Van de Graaff accelerator as a neutron source is described. Information on the change with time of the neutron spectrum is obtained from its reaction with spectrum indicators, the reaction rate being observed by the detection of capture gamma rays. The time resolution may be chosen in the range 0.01 to 5 μs. Measurements were made for water with cadmium, gadolinium, and samarium as indicators dissolved in the medium. A slowing-down time to 0.2 ev of 2.7 ± 0.4 μs and a total thermalization time of 25–30 μs were obtained. From 9 μs after the injection, the results are well described by the assumption of the flux as a Maxwell distribution cooling down to the moderator temperature with a thermalization time constant of 4.1 ± 0.4 μs. (auth)

35354 COHERENT EFFECTS IN SLOW NEUTRON INTERACTIONS WITH LIQUIDS. Vertebnyi, V. P.; Dzyub, I. P.; Maistrenko, A. N.; Pasechnik, M. V. At. Energ. (USSR), 18: 452-5(May 1965). (In Russian)

Total cross sections of liquid nitrogen and oxygen and of gaseous nitrogen were determined in VVR-M reactor for neutrons with the wave range from 4 to 15 Å. The cross

sections of gaseous oxygen and nitrogen increased monotonically with the wavelength and the cross sections of the liquids diminished at $\lambda \approx 5$ to 5.5 Å. It was postulated that the observed effect is related to existing close range order in liquids and is similar to neutron scattering in polycrystals at the wavelength close to $\lambda = 2d$ max. The existence of coherent effects in the heavy water total cross section is discussed. (tr-auth)

35355 A GENERAL PRECISE SOLUTION OF BOLTZMANN EQUATIONS IN SPHERICAL HARMONICS. Rumyantsev, G. Ya. At. Energ. (USSR), 18: 459-63(May 1965). (In Russian)

A general precise solution was derived for the one-velocity Boltzmann equation system in spherical harmonics. The general expression was derived without any approximations and was developed within the limitations of arbitrary functions. The ordinary P_N approximations within their limiting conditions can be easily developed from the general solution. (R.V.J.)

35356 NEUTRON DIFFUSION IN IRON. Golubev, V. I.; Zvonarev, A. V.; Nikolaev, M. N.; Orlov, M. Yu; Penenko, V. V.; Uznadze, O. P. At. Energ. (USSR), 18: 469-73(May 1965). (In Russian)

Experimental and theoretical studies were made of the space-energy distribution of neutrons in the iron screen of the BR-1 reactor. The experimental data are compared with the data on multigroup calculations in P_3 approximation (one-dimensional geometry) and P_1 approximation (two-dimensional geometry). The influence of the increment of the resonance blocking cross sections on the description of neutron distribution in the media was analyzed. (tr-auth)

35357 MEASUREMENTS OF POLARIZED NEUTRON TRANSMISSION THROUGH MAGNETIZED IRON BY A STERN-GERLACH EXPERIMENT. Weber, G. (Angewandte Kernphysik, Kiel). Atomkernenergie, 10: 177-80 (May-June 1965). (In German)

The inhomogeneous field of a Stern-Gerlach-type magnet was used to produce two neutron beams polarized in opposite directions. With these beams, polarized neutrons transmission measurements were made with magnetized soft iron. The results were compared with the theory of Halpern et al. and with single-transmission-effect measurements. The good agreement found showed that the degree of polarization obtained in the experiments differs not more than a few per cent from complete polarization. Transmission measurements as a function of the magnetizing field gave the magnetization curve for high fields. The deviation of the magnetization from saturation was found to vary linearily with 1/H (2×10^3 Oe $\leq$ H $\leq 2 \times 10^5$ Oe). (auth)

35358 CALIBRATION OF THE NPL STANDARD Ra-Be PHOTO-NEUTRON SOURCES BY AN IMPROVED MANGANESE SULPHATE BATH TECHNIQUE. Axton, E. J.; Cross, P.; Robertson, J. C. (National Physical Lab., Teddington, Middx., Eng.). J. Nucl. Energy: Pt. A & B, 19: 409-22(June 1965).

The NPL Photoneutron Sources were recalibrated by an improved manganese sulphate bath technique with a random error of ±0.25 percent. Dependence on an assumed manganese to hydrogen cross-section ratio is eliminated by varying the chemical concentration. This ratio was measured with a standard error of ±0.2 percent. Systematic errors are not expected to exceed ±0.3 percent. Sensitivity of detection is improved by a circulation system which enables the ^{56}Mn activity to be measured during activation of the bath. (auth)

35359 AIR SCATTERING IN NEUTRON CAPTURE CROSS SECTION MEASUREMENTS. Robertson, J. C.; Ryves, T. B. (National Physical Lab., Teddington, Middx, Eng.). Nucl. Instr. Methods, 35: 153-4(1965).

The effect of air scattering on capture cross section measurements is investigated for the case of a detector with an $E^{-0.5}$ cross section dependence, where E is the neutron energy. Both a finite and an infinite air volume around the source are considered, together with the effect of second scattering. (D.C.W.)

35360 A METHOD OF MEASURING THERMAL NEUTRON DECAY. Mueller, K.-H. (CCR Euratom, Ispra, Italy). Nucl. Instr. Methods, 35: 355(Aug. 1965).

A method is proposed for the measurement of thermal neutron decay, and a facility for measuring the decay of a neutron field is outlined. (D.C.W.)

35361 A SOURCE-ADJACENT APPROXIMATION SOLUTION FOR THE MONOENERGETIC STATIONARY ONE-DIMENSIONAL NEUTRON TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING. Schneider, W. (Zentralinstitut fur Reaktorexperimente der KFA, Julich, Ger.). .Nukleonik, 7: 152-60(Mar. 1965). (In German)

The known spherical series for the solution of the transport equation was transformed into an asymptotic series which then rapidly converges, whereas the original series converges very slowly. The approximation was derived, its limits of validity were investigated, and the boundary conditions were formulated. The mathematical results were physically interpreted. It was shown on two simple examples that the solution obtained is not in opposition to what is physically expected. (tr-auth)

35362 AN APPROACH TO SPACE-ENERGY PROBLEMS. Pomraning, G. C. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nukleonik, 7: 192-9 (Apr. 1965). (GA-5948)

A spatial expansion of the equations describing neutron transport is suggested as an approach to the space-energy problem. The diffusion equation in slab and cylindrical geometries and the integro-differential transport equation in slab geometry are considered in detail. It is shown that in the transport equation expansion the angular variable can be analytically eliminated, resulting in equations in the energy variable alone. Application of this method to the region cell problem yields, in lowest order, the neutron balance equations widely used in the study of resonance absorption. (auth)

35363 DAMPING THEORY AND ITS APPLICATION TO NEUTRON SCATTERING BY ANHARMONIC CRYSTALS. Akcasu, A. Z.; Osborn, R. K. (Univ. of Michigan, Ann Arbor). Nuovo Cimento (10), 38: 175-96(July 1, 1965).

The damping theory is developed in terms of projection operators, and an expression for the transition probability per unit time which is suitable to line-shape studies in general is obtained. This expression replaces the usual energy-conserving delta-function by a Lorentzian distribution whose width is equal to the difference of the widths of the initial and final states. Using this expression, a formula for the scattering cross-section of slow neutrons by an anharmonic crystal is derived. Expressions for the width and shift of lines corresponding to multiphonon events in general, and to a one-phonon event as a special case, are obtained, and investigated in the zero- and high-temperature limits. The results are compared to those obtained previously. It is found that the inverse of the phonon lifetime is expressible in terms of the difference of the widths of the crystal states, as obtained by Brout. The shift formula is shown to be in agreement at all temperatures with that obtained by Maradudin and Fein, and others. The width formula agrees with theirs only in the zero-temperature limit. In the high-temperature limit, the present formula predicts a quadratic temperature-dependence in contrast with the linear dependence predicted by theirs. This discrepancy is discussed in terms of the concept of phonon lifetime. The present theory predicts a larger width at finite temperatures, and therefore is expected to yield a better agreement with the large experimental widths observed by Brockhouse et al., than that reported by Maradudin and Fein. (auth)

35364 ONE-PHONON COHERENT NEUTRON SCATTERING FROM CERTAIN POLYCRYSTALLINE MATERIALS. Myers, W.; Summerfield, G. C.; King, J. S. (Univ. of Michigan, Ann Arbor). Phys. Letters, 16: 225-6(June 1, 1965).

An equation is derived that predicts that there are certain materials, principally high polymers, for which one-phonon, coherent peaks appear in the neutron spectrum from polycrystalline materials. (M.O.W.)

35365 DIFFUSION PARAMETERS OF LIQUID HYDROGEN. Bryan, F. A. Jr. (ASTRA Inc., Raleigh, N. C.); Waltner, A. W. Phys. Letters, 17: 129-30(July 1, 1965).

Pulsed neutron experiments on liquid hydrogen were used to determine the thermal diffusion properties of both ortho- and parahydrogen. The experimental measurements were made on two paraorthohydrogen mixtures; 95% parahydrogen, 5% orthohydrogen, and 47% parahydrogen, 53% orthohydrogen. The values of the neutron transport mean free path for pure ortho- and for pure parahydrogen were also calculated from these data. (J.F.P.)

35366 DERIVATION OF KINETIC EQUATIONS FOR SLOW-NEUTRON SCATTERING. Van Leeuwen, J. M. J.; Yip, Sidney (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 139: 1138-51(Aug. 16, 1965).

It is shown that for moderately dense classical gases Van Hove's correlation functions $G(r,t)$ and $G_s(r,t)$ can be calculated from kinetic equations. The kinetic equations are derived from the cluster expansion of a one-particle distribution function which describes the propagation of a density-momentum impulse. For times short compared with the time between collisions, the density series can be used directly. But for longer times a different treatment is necessary because of the increasing importance of multiple collisions. Considering only the dominant terms, the series is shown to be the iterated solution of an integral equation. In lowest order, this equation has the form of a linearized Boltzmann equation in which the collision kernel is nonlocal because of the finite extent of the particles, and is non-Markoffian if the duration of a collision is finite. The approach permits a systematic treatment of coherent as well as incoherent scattering. In particular, we demonstrate an earlier assertion that the appropriate equations for studying the two kinds of scattering are, respectively, the linearized Boltzmann equation and the neutron transport equation. The effects of statistical correlation are introduced approximately in the kinetic equations in lowest order. (auth)

35367 PERFORMANCE OF A GAS FILLED NEUTRON TUBE WITH THE PENNING-TYPE ION SOURCE. Gel, E. P. (All-Union Research Inst. of Geophysical Prospecting, USSR). Pribory i Tekhn. Eksperim., No. 3, 72-4(May-June 1965). (In Russian)

The performance of a small-size neutron generator, operating with a soldered accelerating gas-filled pipe, was investigated. One of the causes of possible unstable operation of the pipe, associated with the peculiarities of an impeded discharge in the Penning-type ion source, is considered. (tr-auth)

35368 NEKOTORYE STATISTICHESKIE I VEROYATNOSTNYE ZADACHI NEITRONNOI FIZIKI. (Some Statistical and Probability Problems in Neutron Physics). Zolotukhin, V. G. Thesis, Moscow, [Gosudarstvennyi komitet po Ispol'zovaniyu Atomnoi Energii. Fiziko-Energeticheskii Institut], 1964. 162p.

Some problems of mathematical-statistical processing of neutron physics measurements are analyzed. The distribution of the number of readings of a neutron detector installed in a reactor is discussed. Semi-analytical Monte Carlo methods for calculating the amplitude distributions of pulses and counting efficiency of recordings of fast neutron scintillation detector are also discussed. 81 references. (R.V.J.)

35369 SOLUTION OF THE DISTRIBUTION EQUATIONS FOR NEUTRONS OR GAMMA-QUANTA IN MULTILAYERED MEDIA BY THE PAIRED COLLISION AND STATISTICAL SUM METHODS. Dyad'kin, I. G.; Zhezhnich, I. D.; Zverev, G. N.; Ruvinskii, M. A. p.3-17 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

A technique is given for a solution of the most general problems of neutron slowing-down and γ-quanta propagation using a combination of analytic methods and the method of statistical sums for computing sextuple integrals. (L.B.S.)

35370 CALCULATION OF SPACE-TIME NEUTRON DISTRIBUTIONS BY THE MONTE-CARLO METHOD. Denisik, S. A.; Rezvanon, R. A.; Lukhminskii, B. E. p.18-34 of Soviet Advances in Nuclear Geophysics. New York, Consultants Bureau, 1965.

Space-time neutron distributions are calculated by a Monte Carlo method in which the path of each neutron is traced from emission from the source to passage across a given energy level (slowing-down) or absorption by matter (diffusion). A flow chart of the computation program for the BESM-P computer is shown, and results are presented of the calculations for slowing-down densities in water, homogeneous dry sandstone (SiO_2) and in sandstone of 20% porosity saturated with fresh water and salt water. (L.B.S.)

Nuclear Properties and Reactions

Refer also to abstracts 34392, 34393, 34458, 34609, 34838, 34881, 34970, 34984, and 35603.

35371 (AD-612914) RESEARCH IN NUCLEAR PHYSICS. Quarterly Progress Report, December 1, 1964–February 28, 1965. (Harvard Univ., Cambridge, Mass. Cyclotron Lab.). Contract Nonr186619. 11p. $1.00(CFSTI).

Reports are presented on research in the following areas: quasi-elastic proton-proton scattering, proton-proton bremsstrahlung, neutron total cross sections, monokinetic neutron beams, n-p incoherent scattering cross sections, radiobiology, whole-body proton exposure, and nuclear magnetism and spectroscopy. (CFSTI)

35372 (ANU-P/349) A CONVERSION FUNCTION FOR CALCULATING ELASTIC SCATTERING ANGULAR DISTRIBUTIONS. Nurzynski, J. (Australian National Univ., Canberra. Research School of Physical Sciences). [1961]. 56p. Dep.(mn).

A conversion function, denoted as $F(x,\Theta)$ was calculated and is tabulated for x between 0.005 and 1.000 in intervals of 0.005 and for the laboratory angles Θ from 2.5 to 180° in intervals of 2.5°. The use of the tables makes possible an easy conversion of the measured intensity of the elastically scattered particles to the ratio σ/σ_R, where σ is the differential cross section for the elastic scattering and σ_R is the Rutherford scattering cross section. (auth)

35373 (BNL-903) ORIENTED NUCLEI. Sailor, Vance L. (Brookhaven National Lab., Upton, N. Y.). Oct. 14, 1964. Contract AT-30-2-GEN-16. 16p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Brookhaven Lecture Series No. 40.

The manner in which nuclear spin and moments behave in an external field to produce nuclear orientation is described, and dynamic and static methods of orientation are reviewed. The details of static-polarization orientation, produced by thermodynamic equilibrium at very low temperatures are discussed. Experiments with polarized nuclei and polarized neutron beams are described, considering the use of the neutron cross sections as a function of energy for determining the assignment of the spin quantum number J to various resonance states. (M.J.T.)

35374 (BNL-9195) THE INTERACTION OF POLARIZED NEUTRONS WITH POLARIZED He^3 NUCLEI ADSORBED IN ZEOLITE. Schermer, R. I.; Passell, L. (Brookhaven National Lab., Upton, N. Y.) [1965]. Contract AT-30-2-GEN-16. 7p. (CONF-650706-15). Dep.(mn); $1.00(cy), 1(mn) CFSTI

From International Conference on the Study of Nuclear Structure with Neutrons, Antwerp.

A detailed description of the experimental procedure is included. The theory of the cross section for a polarized

neutron beam interacting with an ensemble of polarized nuclei is presented. The results and a Curie-Weiss plot of the data are given. (M.O.W.)

35375 (CEA-R-2736) LA RESONANCE GEANTE ET LES ETATS DIPOLAIRES DES NOYAUX LEGERS. (Giant Resonance and Dipolar States of Light Nuclei). Miller, Jacques (Commissariat à l'Énergie Atomique, Saclay (France). Centre d'Études Nucléaires). 1965. 76p. Dep.(mn).

Thesis submitted to Université, Paris.

Cross sections for (γ,n) reactions on ^{12}C, ^{16}O, ^{24}Mg, and ^{40}Ca were measured using monochromatic gamma rays of variable energy obtained from the annihilation in flight of fast positrons. The observed structure is compared with the theoretical predictions of the independent-particle model, taking into account the residual interaction between nucleons by hole-particle method. (auth)

35376 (CONF-641210-17) EVIDENCE FOR PARITY ADMIXTURE IN NUCLEAR STATES. Boehm, F. (California Inst. of Tech., Pasadena). [nd]. Contract AT(04-3)-41. 19p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

From American Physical Society Meeting, Berkeley, Calif.

Two recent experiments which give tentative evidence for the existence of a parity non-conserving nuclear force are reported. One of the experimental procedures is outlined and the experimental problems encountered are listed. Results indicate that the size and sign of the observed effects are in agreement with predictions based on the current-current scheme of weak interaction. (M.O.W.)

35377 (EANDC-43(U)) COMPILATION OF EANDC REQUESTS. (European-American Nuclear Data Committee). Apr. 1965. 52p. Dep.(mn).

A summary of 930 requests for nuclear data is presented. For each request, the isotope, element, or compound, the quantity desired, the energy range, the accuracy, the request priority, the requestors, and the reasons for the request are given. (M.J.T.)

35378 (EANDC(E)-57(U)) NUCLEAR DATA RESEARCH IN THE EURATOM COMMUNITY. Progress Report, July 1, 1963–December 31, 1964. (European American Nuclear Data Committee). Feb. 1965. 194p. Dep.(mn).

Part of report in French.

Research results are presented on fast neutron cross section measurements, fast neutron reactions, neutron inelastic scattering, total neutron cross sections, energy and angular distribution of alpha particles, free-atom neutron cross sections, neutron coherent scattering cross sections, neutron incoherent scattering cross sections, and neutron scattering determinations of diffusion constants for water, phenyls, ZrH, and D_2O. Research results and measurements are also presented on ^{235}U fission product charges, internal conversion electrons, neutron activation cross sections, neutron capture cross sections, isomeric ratios in ^{115}In, neutron scattering in hydrogeneous moderators, heavy nuclei excited states, capture gamma radiation, on-line computers, neutron beams, slow neutron resonances, spin measurements, ternary fission, delayed neutron precursors, cross-sections for fission thresholds, low-energy nuclear reactions, surface barrier detectors, data handling, isotopic standards, thermal neutron reactions, fast neutron reactions, development of apparatus and data reduction methods, measurements of neutron total cross sections for several elements at 400 to 1200 kev, measurements of neutron total cross sections for Al and Ga at 3.6 to 5.3 Mev, neutron physics measurements at 14 Mev, fission neutron emission ratios, cross section for alpha production by $^6Li(d,\alpha)$, helium-5 alpha reactions, deuteron reactions with ^9Be at 150 kev, neutron total cross sections for H, C, F, Al, and V at 2600 to 2850 Mev, reactor physics experiments, criticality studies, experiments with heavy water and graphite matrices, measurements of resonance integrals in MINERVE, thermal neutron cross sections for Al, Mg, Fe, and Cu, and calibration of neutron detectors using Ni. Other experimental work is described on nuclear spectroscopy, nuclear fission, and fast neutron reactions with light nuclei. (J.R.D.)

35379 (IDO-17087) A MACHINE PROGRAM FOR CALCULATING SLOW NEUTRON SCATTERING CROSS SECTIONS WITH EXACT AVERAGING OVER MOLECULAR ORIENTATION. Gannon, L. J.; McMurry, H. L. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). May 1965. Contract AT(10-1)-205. 17p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

A program for the IBM 7040 which calculates the scattering of slow neutrons by semi-rigid molecules in such a way that the correct average is obtained for scattering from all molecular orientations is described. The program is a modification of an earlier one which treats rotations classically, but treats vibrational energy transfers quantum mechanically. The input data are explained, and illustrative applications to CH_4 and C_2H_6 are presented. (auth)

35380 (IFA-CR-51) INTERACTION MEAN FREE PATH OF 9-Gev/c NEGATIVE PIONS IN XENON. Friedlaender, E. M.; Nitu, R. (Institutul de Fizica Atomica R. P. R., Bucharest). Nov. 1964. 10p. Dep.(mn).

The interaction mean free path of 9 Bev/c negative pions was measured in a Xenon bubble chamber by two independent methods, under conditions excluding observational bias. The resulting cross section, (1578 ± 61) mb, is in disagreement with previous measurements and slightly larger than the best interpolated proton value. (auth)

35381 (JINR-P-2097) OPREDELENIE OTNOSHENIYA CHISLA NEITRONOV K CHISLU PROTONOV N_n/N_p NA PERIFERII YADRA KSENONA. (Neutron-Proton Ratio Determination in the Periphery of Xenon Nucleus). Z. S. Strugal'skii (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 14p. Dep.(mn).

The neutron-proton ratio N_n/N_p on the periphery of the Xe nucleus was determined from the analysis of π^--Xe interactions at 9 Bev/c in a xenon bubble chamber. The value of N_n/N_p in the peripheral region of a nucleus is the same as in the whole nucleus, within an accuracy of 11%. (auth)

35382 (JINR-P-2103) K VOPROSU O NEUPRUGOM RASSEYANII SLOZHNYKH YADER S BOL'SHIMI ZARYADAMI. (On Inelastic Scattering of Complex Nuclei With Large Charges). Grabovskii, Ya.; Ivanova, S. P.; Kalinkin, B. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 9p. Dep.(mn).

The effect of dynamic deformation on the process of inelastic scattering of complex nuclei was considered. (auth)

35383 (JINR-P-2142) NEUPRUGOE RASSEYANIE SLOZHNYKH YADER, SOPROVOZHDAEMOE VOZBUZHDENIEM KOLLEKTIVNYKH UROVNEI. (Inelastic Scattering of Complex Nuclei Accompanied by an Excitation of Collective Levels). Kalinkin, B. N.; Grabovskii, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 9p. Dep.(mn).

The relative role of the Coulomb and nuclear mechanisms of excitation of collective levels in inelastic scattering of complex nuclei in the above-barrier energy region is clarified. (auth)

35384 (JINR-P-2153) IZMERENIE SKOROSTI PEREKHODA MYUONA OT pμ-ATOMA K YADRAM DRUGIKH ELEMENTOV. (A Measurement of the Muon Transition Rate From a pμ-Atom to the Nuclei of Other Elements). Basiladze, S. G.; Ermolov, P. F.; Oganesyan, K. O. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 16p. Dep.(mn).

The rates of transfer of a negative muon from a pμ atom to nuclei of C, Ar, and Xe were measured, using an arrangement with a gaseous target, filled with H to 45-atm pressure, and scintillation counters. The values obtained for the rates are well fitted by $\lambda_z = z$. (auth)

35385 (JINR-P-2166) O POZITRONNOM RASPADE Eu^{147}. (On the Positron Decay of Eu^{147}). Gromov, K. Ya.; Zhelev, Zh.; Kun, Hsian-chin; Muziol, G.; Hang, Shu-zhung (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 9p. Dep.(mn).

It was established that, in the β^+ decay of ^{147}Eu, the ground, 122-kev, and 198-kev levels of ^{147}Sm are populated with intensities 0.15, 0.10, and 0.13% per decay, respectively, using measurements of triple coincidences between the 0.511-kev annihilation quanta and the quanta of the whole gamma spectrum. The $^{147}Fu \rightarrow {}^{147}Sm$ decay energy was determined to be 1652 ± 15 kev. The results obtained are compared with the data of other works. (tr-auth)

35386 (JINR-P-2167) POZITRONY PRI RASPADE Gd^{147}. (Positrons in Decay of Gd^{147}). Gromov, K. Ya.; Zhelev, Zh. T.; Kalinnikov, V. G.; Kuznetsov, V. V.; Kun, Hsian-chin; Muziol, G.; Hang, Shu-zhung; Khalkin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 11p. Dep.(mn).

Measurements were made of the triple coincidences between γ quanta with 511–511 kev and those of the whole γ spectrum, using a scintillation γ spectrometer. A measurement of the β^+ spectrum using a β spectrometer with three-fold focusing was also carried out. It was established that the spectrum consists of two components with energies 970 ± 15 and 1250 ± 50 kev, populating the levels with energies 229 and 0 kev of ^{147}Eu with intensities (0.20 ± 0.04) and (0.028 ± 0.006) % per decay respectively. The decay energy of $^{147}Gd - {}^{147}Eu$ is 2220 ± 15 kev. According to the analysis of the experimental data the value $^9/_2^-$ should be assigned to the ground state of ^{147}Gd. (auth)

35387 (JINR-P-2196) NOVYE IZOTOPY Er^{157}, Er^{156}, I Ho^{157}. (New Isotopes of Er^{157}, Ho^{157}, and Er^{156}). Zhelev, Zh. T.; Kalinnikov, V. G.; Kudryavtseva, A. V.; Makarov, S. P.; Muziol, G.; Kherrmann, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 12p. Dep.(mn).

The new isotopes ^{157}Er, ^{157}Ho, and ^{156}Er were identified using a magnetic β spectrometer and a scintillation γ spectrometer. The identification was made by genetic bindings with the daughter isotopes. The values of the half lives for ^{157}Er, ^{157}Ho, and ^{156}Er are given, equal to $(24 \pm {}^{3}_{2})$, $(18 \pm {}^{3}_{2})$, and (≤ 12) min, respectively. (auth)

35388 (KFK-307) A RE-EVALUATION OF THE COUPLING CONSTANTS IN BETA DECAY. Buehring, H.; Schopper, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fur Experimentelle Kernphysik). Feb. 1965. 6p. Dep.(mn).

The f exact wave function was calculated for the neutron and for ^{14}O, using an exact solution of the Dirac equation taking electron screening into account; results are compared with those from previous calculations. Previously calculated values for radiative corrections and corrections for finite nucleon size and for competition from K capture are used to obtain values for total additional corrections to the f values. The final corrected f values are shown, and ft values are derived and used to calculate g_V and the axial vector coupling constant. (M.J.T.)

35389 (KFK-313) THE CHARGE-DEPENDENT NUCLEAR INTERACTION AND FERMI MATRIX ELEMENTS OF β DECAY. Schopper, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fur Experimentelle Kernphysik). Mar. 1965. 5p. Dep.(mn).

Deviations from charge independence of nuclear forces can be found by determining the Fermi matrix elements M_F of $\Delta T = \pm 1$ beta transitions from β-γ circular polarization correlations or beta asymmetries from polarized nuclei. Data on the β-γ circular polarization correlation of ^{24}Na, ^{41}Ar, ^{44}Sc, ^{52}Mn are used to derive the constants in expressions for M_F based on a charge-dependent nuclear potential model previously developed. The M_F values thus obtained are presented. (M.J.T.)

35390 (LA-3281) BIBLIOGRAPHY OF POLARIZATION AND ELASTIC SCATTERING OF PROTONS AND NEUTRONS FROM NUCLIDES. Winsor, R. V. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Dec. 31, 1964. Contract W-7405-eng-36. 55p. Dep.(mn); $3.00(cy), 1(mn) CFSTI.

References to polarization and elastic scattering of protons and neutrons from all nuclides at energies to 50 Mev are given, for Jan. 1958 to Dec. 1964. Nuclear Science Abstracts was the only source searched. Notes are given indicating whether the NSA abstract mentions polarization, elastic or inelastic scattering, and energy range. (M.J.T.)

35391 (LA-DC-6516) NUCLEAR MAGNETIC SHIELDING OF A HYDROGEN ATOM IN THE FIELD OF AN ELECTRIC DIPOLE. Roberts, Edwin M. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [nd]. Contract W-7405-eng-36. 35p. Dep.(mn); $2.00(cy), 1(mn) CFSTI

The wave function for a hydrogen atom in the field of an electric dipole is found to first order in perturbation theory. The potential function of the dipole is expanded in multiple form about the proton. The proton and dipole are assumed to be held in a fixed configuration. The effect of the dipole, on the electron, is assumed to be effectively given by the potential interior to a sphere of which the surface passes through the point dipole and the center is at the proton. The first order correction to the wave function is in the form of an infinite series. The magnetic shielding factor is calculated. The anisotropic shielding factor contains a part linear in the dipole strength, p; it may be positive or negative depending on the configuration of the atom-dipole pair. The term linear in p is due to the part of the dipolar potential proportional to P_2 (μ). The isotropic shielding factor, σ, contains a part quadratic in p but not a part linear in p. The diagmagnetic and paramagnetic contributions to σ, both of which are negative, are calculated separately. The paramagnetic contribution is calculated with somewhat more accuracy than the diamagnetic contribution. Numerical results are given and discussed. (auth)

35392 (LAL-1132) ELECTRON-NUCLEUS SCATTERING AT 180°. Goldemberg, J. (Laboratoire de l'Acceleratuer Lineaire, Univ. de Paris, Orsay (France)). Apr. 1965. 31p. Dep.(mn).

The experimental set-up to measure large-angle electron scattering at relativistic energies is described, including the magnetic spectrometer and auxiliary deflecting magnet. Examples of the use of large-angle scattering in nuclear spectroscopy are discussed, including obtaining data on static magnetic moments of light nuclei and their form factors, on spin-parity and width of magnetic transitions, and on excitation of El levels in the giant resonance region. Possibilities of large-angle scattering studies for investigating the nonexistence of an electric dipole moment of the electron, the universality of weak interactions in nuclear muon capture, and the role of exchange currents in the nucleus are considered. Examples of previous experimental and calculated results illustrating these applications are cited. (M.J.T.)

35393 (LNF-65/6) FOTOPRODUZIONE DI K^+ DA NUCLEO COMPLESSO. (Photoproduction of K^+ From Complex Nuclei). Note No. 272. Knoke, F. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Feb. 26, 1965. 16p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

The spectral distribution of K^+ in the laboratory system is calculated as a function of the angle of emission and the energy of the incident photon. The matrix element of photoproduction is calculated in the pulse approximation hypothesis. The effect of the optical potential on the moment distribution density of nucleons in the nucleus is discussed. (J.S.R.)

35394 (N64-29785) INTRODUCTION TO NUCLEAR PROPULSION. LECTURE 2, BASIC PHYSICS. Thornton, Gunnar (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 1963. Contract NAS8-5215. 30p. (GEMP-190b; NASA-CR-52960) $3.60(CFSTI)

Elementary nuclear physics concepts are discussed to provide a general understanding in terms of more familiar phenomena. A more detailed treatment of some aspects of nuclear radiation physics is presented. (M.O.W.)

35395 (NP-14993) VECTOR MESON EMISSION BY LEPTONS IN NUCLEAR COULOMB FIELDS (thesis). Andersen, Carl M. (Pennsylvania Univ., Philadelphia. Dept. of Physics). 1964. 138p.

It is proposed that experiments be undertaken to study the emission of vectons (V^0), i.e., neutral, charge-conjugation-minus, strangeness-zero, spin-one, parity-minus mesons, by very high energy electrons or muons incident on the Coulomb fields of high-Z nuclei. A determination of the cross section for this process (the VECF process) would yield the strength of the lepton-lepton-vecton coupling and thus provide an indirect way of measuring decay rates of the type $V^0 \rightarrow l^+ + l^-$, where $V^0 = \phi, \omega, \rho^0, \cdots$, and $l^\pm = e^\pm, \mu^\pm$. The cross section for the VECF reaction $l^\pm + Z \rightarrow l^\pm + V^0 + Z$, where the V^0 is emitted from a lepton-lepton-vecton vertex, is derived and compared with that for the bremsstrahlung process, which has similar Feynman diagrams. Numerical calculations are described which give the magnitude of the total cross section for the VECF process and illustrate the shapes of various VECF differential cross sections in the case where $V^0 = \phi$ and $l^\pm = e^\pm$. The feasibility of the VECF experiments depends mainly on the extent to which background events are present and can be differentiated from the VECF events by a study of angular distributions, energy spectra, and time correlations of the final state particles. Three background processes in the proposed ϕECF:e experiment, where the ϕ is to be detected by observation of its K^+K^- decay pair, are considered. The first of these backgrounds involves the production of even orbital angular momentum K^+K^- pairs via $\gamma_1 + \gamma_2 \rightarrow K^+ + K^-$, where γ_1 and γ_2 are virtual photons emitted by the electron and the nucleus, respectively. The second involves production of ϕ mesons (which decay into unit orbital angular momentum K^+K^- pairs) at a nucleus-nucleus-vecton vertex, and the third the production of ϕ mesons at a photon-"meson"-vecton vertex where the "meson" is taken to have finite mass and quantum numbers like the vacuum. It is shown through the use of numerical calculations that in a small, but experimentally accessible, region of the final particle phase space the ϕECF:e cross section is relatively large while the cross sections of the three background processes are negligible. Comments on the background processes in other VECF experiments are made. It is concluded that experiments involving the emission of ϕ mesons by high energy electrons incident on nuclear Coulomb fields constitute a promising way of determining the decay rate of $\phi \rightarrow e^+ + e^-$ and that other decay rates of the type $V^0 \rightarrow l^+ + l^-$ may possibly also be determined via VECF experiments. (auth)

35396 (NP-15095) OPTICAL MODEL PREDICTIONS OF NEUTRON CROSS SECTIONS FOR N^{14}. Johansson, B. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). June 1965. 10p. Dep.(mn).

The total neutron cross section and the differential cross section for neutron elastic scattering from ^{14}N were calculated as functions of energy by making interpolations in optical model parameters. (auth)

35397 (ORNL-P-1302) THE INTERACTION OF 350 kev POLARIZED NEUTRONS WITH ORIENTED ^{165}Ho NUCLEI. Wagner, R.; Miller, P. D.; Tamura, T. (Oak Ridge National Lab., Tenn.); Marshak, H. (National Bureau of Standards, Washington, D. C.). [1965]. Contract W-7405-eng-26. 5p. (CONF-650706-12) Dep.(mn); $1.00(cy), 1(mn) CFSTI

From International Conference on the Study of Nuclear Structure with Neutrons, Antwerp.

The interaction of polarized and unpolarized 350-kev neutrons with oriented and unoriented ^{165}Ho nuclei was investigated in order to search for a possible spin-spin interaction and to study also the influence due to nuclear deformation. A deformation effect in the total cross section of the oriented target was found to be in quantitative agreement with a coupled-channel calculation. The spin-spin interaction was found to be more than one order of magnitude smaller than the spin-orbit interaction for this nucleus. (M.O.W.)

35398 (ORNL-P-1304) ENERGY DEPENDENCE OF THE $^{10}B(n,\alpha)/^{10}B(n,\alpha\gamma)$ RATIO. Macklin, R. L.; Gibbons, J. H. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 9p. (CONF-650706-11). Dep.(mn); $1.00(cy), 1(mn) CFSTI

From International Conference on the Study of Nuclear Structure with Neutrons, Antwerp.

A study of the cross section ratio is presented. Experimental results indicate a resonance near 530 kev on the cross section ratio. Results show that the ratio remains within about 5% of the thermal value for neutron energies up to about 30 kev, after which it rises in a slow, continuous fashion. These new values for the cross section ratio in the $7 < E_n < 170$ kev range cause a change of less than 1.5% in the shape of the $(n,\alpha\gamma)$ cross section assumed for flux calibration in earlier work on heavy element capture cross sections. (M.O.W.)

35399 (ORNL-P-1307) NEUTRON RESONANCE CAPTURE IN 2s-1d SHELL NUCLEI. Bergqvist, I.; Biggerstaff, J. A.; Gibbons, J. H.; Good, W. M. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 5p. (CONF-650706-10). Dep.(mn); $1.00(cy), 1(mn) CFSTI

From International Conference on the Study of Nuclear Structure with Neutrons, Antwerp.

A neutron resonance capture experiment in the mass region $19 \leq A \leq 40$ is reported. The gamma ray spectra from the capture in two resonances in $^{24}Mg(n,\gamma)$ are analyzed. A discussion of s-wave resonance and s-wave thermal capture spectra is included. The $^{27}Al(n,\gamma)$ and $^{32}S(n,\gamma)$ reactions were also investigated. (M.O.W.)

35400 (ORNL-P-1343) FAST NEUTRON CAPTURE GAMMA-RAY SPECTRUM FROM $^{238}U(n,\gamma)^{239}U$. Bergqvist, I. (Oak Ridge National Lab., Tenn. and Forsvarets Forskningsanstalt, Stockholm (Sweden)). [1965]. Contract W-7405-eng-26. 6p. (CONF-650706-4). Dep.(mn); $1.00(cy), 1(mn) CFSTI

From International Conference on the Study of Nuclear Structure with Neutrons, Antwerp.

A comparison between the calculated and experimentally determined spectra of $^{238}U(n,\gamma)^{239}U$ is presented. Results indicate agreement within an estimated uncertainty of about 10% over the whole range of pulse heights except for the bumps at 3.6 and 4.0 Mev in the measured spectrum. An analysis of these bumps is presented. (M.O.W.)

35401 (ORNL-P-1346) NEUTRON RESONANCE STRUCTURE AND S-WAVE STRENGTH FUNCTION OF THE EVEN ISOTOPES OF ZIRCONIUM. Biggerstaff, J. A.; Good, W. M.; Kim, H. J. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 4p. (CONF-650706-7). Dep.(mn); $1.00(cy), 1(mn) CFSTI

From International Conference on the Study of Nuclear Structure with Neutrons, Antwerp.

In order to furnish more detail on the role of magic number so far as strength function is concerned, the total cross sections of the even isotopes of zirconium are presented. Preliminary results were previously reported and the present results represent extension of the measurements to 60 kev with thicker samples. The samples consisted of at most 12 grams at about 80% purity in the case of ^{96}Zr and at most 50 grams of better than 95% purity in the cases of $^{90,92,94}Zr$. All samples were in the form of oxides. (M.O.W.)

35402 (ORNL-P-1353) HIGH RESOLUTION MEASUREMENTS OF GAMMA RAYS FROM THERMAL AND RESONANCE NEUTRON CAPTURE IN ^{117}Sn, ^{118}Sn AND ^{120}Sn. Harvey, J. A.; Slaughter, G. G. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 5p. (CONF-650706-9). Dep.(mn); $1.00(cy), 1(mn) CFSTI

From International Conference on the Study of Nuclear Structure with Neutrons, Antwerp.

High resolution measurements of the gamma ray spectra from thermal and resonance neutron capture in ^{117}Sn, ^{118}Sn, and ^{120}Sn were made with a lithium-drifted germanium detector. The energies and intensities of the gamma rays from neutron capture in ^{117,118,120}Sn are tabulated. (M.O.W.)

35403 (ORNL-P-1354) LEVEL SPACING AND S-WAVE NEUTRON STRENGTH FUNCTION OF THE ODD-Z ODD-N NUCLIDE ^{138}La. Harvey, J. A.; Slaughter, G. G. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 4p. (CONF-650706-2) Dep.(mn); $1.00(cy), 1(mn) CFSTI

From International Conference on the Study of Nuclear Structure with Neutrons, Antwerp.

Neutron transmission measurements from 0.2 to 2000 ev in 4 different energy ranges were made with the ORR fast chopper time-of-flight neutron spectrometer using BF_3 proportional counters at the 45 meter flight station. Diagrams are given relating the time of flight and transmission data. A brief discussion of the resonances is included. (M.O.W.)

35404 (ORNL-P-1371) S-WAVE NEUTRON STRENGTH FUNCTIONS OF ISOTOPES IN THE 3-s RESONANCE REGION 40 SMALLER THAN A SMALLER THAN 70. Wagner, R.; Good, W. M.; Paya, D. (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 5p. (CONF-650706-5). Dep.(mn); $1.00(cy), 1(mn) CFSTI

From International Conference on the Study of Nuclear Structure with Neutrons, Antwerp.

The even-even compound nuclides consisting of ^{44}Ca, ^{46}Ti, ^{50}Ti, ^{54}Cr, ^{58}Fe, and ^{62}Ni are studied in the mass region of the 3s strength function resonances. The Li(p,n) reaction and a relatively thick target are employed to measure transmissions by time-of-flight in the energy range 2–60 kev with an energy precision of better than 2%. Diagrams give the total cross sections of the nuclides. The s-wave strength function and average level spacing are tabulated. Data are used to classify the nuclei in the region of the 3s giant resonance according as the compound nuclei are even-even, odd-odd, or even-odd. (M.O.W.)

35405 (UCRL-11681) SCATTERING OF 50.9 Mev ALPHA PARTICLES FROM Ne^{20} AND Ca^{40} (thesis). Springer, Arthur (Lawrence Radiation Lab., Univ. of California, Berkeley). May 6, 1965. Contract W-7405-eng-48. 131p. Dep.(mn); $4.00(cy), 3(mn) CFSTI.

More than a dozen inelastic levels of both ^{20}Ne and ^{40}Ca were excited by inelastic scattering of 50.9 Mev alpha particles. Differential cross sections for these excitations were measured, and by analysis with the Austern and Blair model, one-step and two-step excitation processes were distinguished from each other. Spins, parities, and reduced transition probabilities were also extracted with the aid of this model. This information was then used to discuss the collective nuclear structure of ^{40}Ca, which is vibrational, and ^{20}Ne which has rotational bands based on both the ground state and octupole vibrations. (auth)

35406 (ANL-Trans-177) YIELD CROSS-SECTIONS OF γ-QUANTA AND OF THE EXCITATION OF NUCLEAR LEVELS AT INELASTIC NEUTRON SCATTERING. Broder, D. L.; Lashuk, A. I.; Sadokhin, I. P. Translation by Elmar K. Wilip (Argonne National Lab., Ill.), of "Secheniya Vykhoda Gamma-Kvantov i Vozbuzhdeniya Urovnei Yader pri Neuprugom Rasseyanii Neitronov." 1964. 17p. Dep.(mn); $1.00(cy), 1(mn); CFSTI; $1.60(fs), $0.80(mf) JCL.

Measurements of cross sections for formation of γ-quanta inelastic scattering of neutrons on Mg, ^{52}Cr, Fe, ^{58}Ni, ^{60}Ni, Zr, Nb, and Sb. The results are obtained by means of a scintillation spectrometer with a NaI(T1) crystal. The energetic resolution of the ^{137}Cs γ-line at 0.661 Mev is ~10%. Monochromatic neutrons are obtained by means of the reactions ^{3}H(p,n)^{3}He and ^{2}H(α,n)^{3}He. The neutron energy scattering did not exceed ±30 kev and ±100 kev, respectively. The cross sections of excitation of single levels of Mg, ^{52}Cr, ^{56}Fe, ^{58}Ni, ^{60}Ni, and Nb and the total cross sections of inelastic scattering on Mg, Fe, Ni, and Nb have been determined on the basis of known decay schemes of excited states. The results are shown graphically. (auth)

35407 TOTAL AND DIFFERENTIAL CROSS SECTIONS OF URANIUM AND THORIUM FISSION BY LOW ENERGY DEUTERONS. Nemilov, Yu. A.; Pavlov, V. V.; Selitskii, Yu. A.; Solov'ev, S. M.; Eismont, V. P. At. Energy. (USSR), 18: 456-9(May 1965). (In Russian)

A glass and mica method of recording fission fragments was used in order to determine the total and differential cross sections of ^{232}Th, ^{233}U, ^{235}U, and ^{238}U fission by deuterons with energies considerably below the Coulomb barrier (6.6 Mev and less). The results were correlated with published data on identical magnitudes obtained by means of semiconductor detectors. During the deuterons irradiation of nuclei with different neutron fission thresholds the reactions preceding the fission varied considerably. (tr-auth)

35408 DETERMINATION OF THE RELATIVE RATE OF FISSION REACTIONS FOR VARIOUS ISOTOPES BY RECORDING GAMMA EMISSION FROM ^{140}La FISSION FRAGMENT. Yurova, L. N.; Bushuev, A. V. At. Energ. (USSR). 18: 518-19(May 1965). (In Russian)

Experiments were made to determine the feasibility of using the γ spectrometer method for measuring the fission reaction rates for ^{232}Th, ^{235}U, ^{238}U, and ^{239}Pu. The γ-emission spectrum of ^{239}Pu and ^{238}U fission fragments at 1.2 to 2 Mev, measured with scintillation spectrometer with 40 × 40 mm NaI(Tl) crystal and 100-channel amplitude analyzer after five days following tens of hours of exposure did not show any interfering activity under the 1.6-Mev ^{140}La photopeaks. The ratio of fission cross sections for ^{239}Pu and ^{238}U isotopes was determined by measuring the area under the 1.6-Mev photopeaks in the spectra of the reactor irradiated isotopes. Tabulated data of the ^{238}U and ^{235}U fission ratio measured with a γ-spectrometer and a fission chamber showed that the γ-spectrometer method is efficient in the cases in which the integral fast neutron flux is $\geq 10^{13}$ fast neut./cm^2. Experiments with thorium specimens in a fast reactor and plutonium in a thermal reactor confirmed the method of recording ^{140}La γ rays for measuring ^{232}Th and ^{239}Pu fission rate. (R.V.J.)

35409 ON THE PROBLEM OF ENERGY DISTRIBUTION OF ALPHA PARTICLES EMITTED FROM A THICK SOURCE. Ershov, E. B.; Karan, A. A.; Shamov, V. P. At. Energ. (USSR), 18: 519-20(May 1965). (In Russian)

An empiric shape of alpha particle spectrum was analyzed in order to determine the range-energy relation in a thick source. The spectrum was measured using an ionization α-chamber with 100-channel amplitude analyzer and integral background of ~3 pulse/min. Compressed (~2 mm thick ~3 cm^2) preparations contained ^{239}Pu evenly distributed in the talc mass. The empiric spectrum shape N(E) for $E \leq E_{max}$ was measured in four ranges: 0.1 to 0.8, 0.8 to 2.0, 2 to 4, and 4 to 5 Mev. The results showed that the suggested method can be effectively used for determining characteristics of complex of thick α-sources. (R.V.J.)

35410 ELASTIC SCATTERING OF 14-Mev NEUTRONS BY BERYLLIUM. Roturier, Jacques; Irigaray, Jean-Leon; Petit, Georges Yves (Faculte des Sciences, Bordeaux). Compt. Rend., 260: 4491-4(Apr. 26, 1965). (In French)

The differential cross section for the elastic scattering of 14-Mev neutrons by ^{9}Be were measured for scattering angles between 7°30′ and 170° in the laboratory system. The results were compared with the theoretical curve calculated from the black nucleus model and with the theoretical curve calculated from the optical model. (tr-auth)

35411 MÖSSBAUER EFFECT IN W^{182} STUDIED BY THE GAMMA-GAMMA COINCIDENCE METHOD. Boncev, C.; Mitrani, L.; Ormandziev, S. Compt. Rend. Acad. Bulgare Sci., 16: 15-18(1963).

The effect of nuclear resonance scattering of 100 kev gamma-ray quanta ^{182}W is studied. To decrease the background of the γ-quanta of energy 152, 222, 229, 264 kev, that are subjected to Compton scattering by the tungsten scatterer, only those Moessbauer quanta (100 kev) have been registered that were coincident with one of the γ-quanta, recorded on their turn in another detector. The source and the scatterer were placed into a nitrogen cryostat. A change of the resonance scattering was achieved through source heating. The difference of the coincidences at nitrogen and at room temperature of the source, related to the coincidences at nitrogen temperature is equal to 9.5 ± 3.5 per cent. In conclusion it is considered that the application of such experimental methods might in many cases increase considerably the Moessbauer effect. (auth)

35412 NEUTRON CAPTURE CROSS-SECTIONS OF ^{126}Xe AND ^{136}Xe. Bresesti, M.; Cappellani, F.; Del Turco, A. M.; Neumann, H.; Orvini, E. (C.C.R., Euratom, Ispra, Italy). J. Inorg. Nucl. Chem., 27: 1175-81(June 1965).

The thermal neutron capture cross section of ^{126}Xe, its resonance-capture integral (from 0.55 ev to ∞), and its effective cross section in a reflector position of the Ispra I reactor were found to be $\sigma_0 = 2.20 \pm 0.22$, RI = 38.0 ± 3.8, and $\hat{\sigma}_0 = 2.45 \pm 0.25$ b, respectively. These values were determined by irradiating natural xenon and measuring the activity of ^{127}Xe. The thermal neutron capture cross section of ^{136}Xe was found to be $\sigma_0 = 0.281 \pm 0.028$ barns. This value was determined by irradiating natural xenon in a well-thermalized position of the Ispra I reactor and measuring the activity of ^{137}Cs, the decay product of ^{137}Xe. The neutron fluxes were measured with cobalt monitors. All values were calculated according to the Westcott convention. (auth)

35413 MASS YIELDS IN THE FAST NEUTRON FISSION OF ^{233}U. Bunney, L. R.; Scadden, E. M. (Naval Radiological Defense Lab., San Francisco). J. Inorg. Nucl. Chem., 27: 1183-9(June 1965).

The cumulative yields of sixteen mass chains in the fission of ^{233}U by fission-spectrum neutrons were determined by radiochemical methods. The mass chains were mostly in the rare earth region of the yield curve. In general, the last radioactive member of the mass chain was isolated and its activity measured relative to the activity of ^{99}Mo. With this ratio, with pertinent data from the thermal neutron fission of ^{235}U, and with the absolute yield of mass 99 in the fission-spectrum neutron fission of ^{233}U, the chain yield was calculated. The accuracy of the determinations was estimated to be ±15%, except for mass 161 where it was estimated to be ±30%. The mass-yield curve for the fission-spectrum neutron fission of ^{233}U was outlined by reflecting the yield values with the assumption that the average number of neutrons emitted per fission was 2.5. The mass yields in the fission-spectrum neutron fission of ^{233}U differed from the mass yields in the thermal neutron fission of ^{233}U in a manner analogous to the behavior of these same mass yields in the fission-spectrum and thermal neutron fission of ^{235}U. (auth)

35414 EXACT EIGENSTATES OF THE PAIRING-FORCE HAMILTONIAN. [PART] II. Richardson, R. W. (New York Univ., New York) J. Math. Phys. (N. Y.), 6: 1034-51(July 1965).

The restrictions on a previously reported class of exact eigenstates of the pairing-force hamiltonians are removed and it is indicated that all the eigenstates of this hamiltonian can be included in this class. Explicit expressions are given for the expectation values of one- and two-body operators in the exact, seniority-zero eigenstates of this hamiltonian. In particular, a simple expression for the occupation probabilities of the levels of the single-particle potential is given. This expression may be easily evaluated for realistic nuclear systems. (auth)

35415 ASYMPTOTIC REDUCED-WIDTH AMPLITUDE DISTRIBUTIONS. Ullah, Nazakat (Tata Inst. of Fundamental Research, Bombay). J. Math. Phys. (N. Y.), 6: 1102-5(July 1965).

The method of moments is used to derive the reduced-width amplitude distributions. The explicit dependence of the distribution function on the dimension N of the random orthogonal matrix for large values of N is obtained. It is shown that in the limit N → ∞, the distribution is the same as the one obtained using the explicit assumption of level independence. (auth)

35416 THE FISSION CROSS SECTIONS OF ^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{237}Np, ^{239}Pu, ^{240}Pu, AND ^{241}Pu FOR 24 kev NEUTRONS. Perkin, J. L. (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.); White, P. H.; Fieldhouse, P.; Axton, E. J.; Cross, P.; Robertson, J. C. J. Nucl. Energy: Pt. A & B, 19: 423-437(June 1965).

The fission cross sections of various nuclides were measured using 24-kev neutrons from an Sb–Be photoneutron source. The neutron flux from this source was determined either directly or indirectly by means of three independent absolute flat response detectors; namely the NPL manganese bath, the AWRE oil bath and the AERE boron pile. The values of the cross sections obtained, in barns, are as follows. ^{233}U 2.73 ± 0.11, ^{234}U 0.015 ± 0.004, ^{235}U 2.36 ± 0.06, $^{236}U \leq 0.004$, ^{237}Np 0.011 ± 0.002, ^{239}Pu 1.66 ± 0.07, ^{240}Pu 0.106 ± 0.018, ^{241}Pu 2.83 ± 0.21. These results are compared with previous measurements at or near this energy. (auth)

35417 GAMMA-RAY YIELDS FROM INELASTIC NEUTRON SCATTERING OF 14.1 Mev NEUTRONS FROM SODIUM, MAGNESIUM, SILICON, SULPHUR, MANGANESE, AND IRON. Martin, P. W.; Stewart, D. T. (Univ. of Glasgow, Scotland). J. Nucl. Energy: Pt. A & B, 19: 447-9(June 1965).

The observation of de-excitation γ rays following inelastic neutron scattering, or neutron-induced reactions, can provide information on the decay scheme and energy levels of the de-exciting nucleus and a knowledge of the absolute yield of these γ rays is of interest for fast reactor design. The measurements of cross sections for production of γ rays in sodium magnesium, silicon, sulphur, manganese, and iron, arising from the interaction with 14-Mev neutrons are reported. (auth)

35418 TWO-PROTON RADIOACTIVITY OF NUCLEI HEAVIER THAN TIN. Gol'danskii, V. I. (Inst. of Chemical Physics, Academy of Sciences, USSR). JETP Letters (USSR) (English Transl.), 1: 83-6(May 1, 1965).

Two-proton radioactivity in the Z = 50–82 region is investigated. Nuclear decay phenomena are discussed with the relative abundance of the various decay modes. The presence of a centrifugal barrier besides the Coulomb barrier suppresses the single-proton decay thus contributing to the predominance of alpha and two-proton decay. Curves are included which show the relations of the decay modes. (J.F.P.)

35419 ESTIMATION OF DIRECT- AND COMPOUND-NUCLEAR REACTION CROSS-SECTIONS IN $Al^{27}(p,p')Al^{27}$ IN THE ENERGY RANGE OF 6.5- TO 14 Mev. Kokame, Jun; Fukunaga, Kiyoji (Kyoto Univ.). J. Phys. Soc. Japan, 20: 649-57(May 1965).

An attempt was made to estimate the cross sections of direct interactions and the compound nuclear process separately, using the experimental data of $^{27}Al(p,p')^{27}*Al$ scattering. Under three assumptions, the similarity of the probability of direct collective excitations by alpha particles and protons, the 2J + 1 rule for the yield of the compound nuclear process, and a negligible effect of the interference between both the processes: the cross sections of direct interactions, summed up the lower six proton groups, were estimated to be about 80 mb over the energy range of 8.5 to 14 Mev of incident protons. On the other hand, the compound part decreases exponentially from 140 mb to 30 mb in the same energy range. (auth)

35420 IONIZATION YIELD OF THE $N^{14}(n,p)C^{14}$ REACTION IN AIR. Ishiwari, Ryutaro (Kyoto Univ.) J. Phys. Soc. Japan, 20: 658-69(May 1965).

The ionization yield of the $^{14}N(n,p)^{14}C$ reaction produced by thermal neutrons in air was measured with a pulse ionization chamber. The uncorrected value of the reaction

energy was obtained as 0.600 ± 0.006 Mev. This value was corrected for columnar recombination and for the variation of W, the average energy to produce an ion pair, with particle energies. For the variation of W_α, the empirical formula obtained in the previous work was used. Assuming that W_p is equal to W_α for the same velocity and that the relative value of W_C with respect to Po alpha particles is 1.10, the corrected reaction energy was calculated as 0.621 ± 0.006 Mev in good agreement with the established Q value. This result indicates that W_p for about 600 kev is actually equal to W_α for the same velocity in air. Some evidences, which suggest that the relative value of W_C is about 1.10 and W_α for the same velocity as ^{14}C is probably equal to this value, were also discussed. (auth)

35421 THE $Al^{27}(p,p)Al^{27}$ REACTION. Awaya, Takashi (Tokyo Univ.). J. Phys. Soc. Japan, 20: 669-78(May 1965).

The excited states of ^{28}Si were studied by the $^{27}Al(p,p)^{27}Al$ reaction in the energy region E_p = 770 − 1390 kev. Definite anomalies of the excitation functions were observed at 140°46′ c.m. for the 991, 1117, 1182, 1198, 1362, 1380, and 1387 kev resonances and an ambiguous one for the 936 kev. For the 1117, 1182, and 1198 kev resonances the excitation functions were studied at 90° c.m. too. The results were analyzed by the R-matrix formalism taking into account the energy spread which came from the beam energy spread and the target thickness. The spin-parities of the 1117, 1182, and 1198 kev resonances were determined to be 3^- or 4^-, 2^+, and 3^-, respectively. (auth)

35422 ELASTIC SCATTERING OF PROTONS FROM Cu^{63} AND Cu^{65} IN THE ENERGY RANGE FROM 7.54 Mev TO 14.64 Mev. Koike, Masahiro; Maki, Takashi; Matsuda, Kazuhisa; Mikumo, Takashi; Nagahara, Yukio; Nonaka, Itaru; Suzuki, Arata; Kikuchi, Ken (Tokyo Univ.). J. Phys. Soc. Japan, 20: 679-84(May 1965).

Energy dependence of the elastic scattering of protons from ^{63}Cu and ^{65}Cu were investigated between 7.5 and 14.6 Mev. At four angles of 30, 60, 95, and 165°, differential cross sections were measured at about every 200 kev and angular distributions were also observed at every 800 kev for both isotopes. The observed angular distributions showed the typical diffraction patterns. An optical model analysis was made for every angular distribution and the parameters of the optical potentials were obtained as functions of incident energies. (auth)

35423 MÖSSBAUER EFFECT AT ^{114}Sn NUCLEI INTRODUCED INTO YTTRIUM IRON GARNET LATTICE. Belov, K. P.; Lyubutin, I. S. (Crystallography Inst., Academy of Sciences, USSR). JETP Letters (USSR) (English Transl.), 1: 16-19(Apr. 1, 1965).

Investigation of ferrodielectrics, in which conduction electrons make no contribution to the effective field of the nonmagnetic-ion nucleus, is made with an yttrium iron garnet. The absorption spectrum was found to consist of six components. The value of the effective field was calculated from the splitting of the ground state. It is concluded that the field at the tin nuclei in the yttrium iron garnet is due to polarization of the electronic core of the tin atom by the exchange fields of the 3d electrons of the iron atoms. (J.F.P.)

35424 SUPER-EXCHANGE INDUCTION OF MAGNETIC FIELDS AT THE NUCLEI OF NONMAGNETIC ATOMS. Gol'danskii, V. I.; Trukhtanov, V. A.; Devisheva, M. N.; Belov, V. F. (Inst. of Chemical Physics, Academy of Sciences, USSR). JETP Letters (USSR) (English Transl.), 1: 19-22(Apr. 1, 1965).

The experimental observation of indirect exchange induction of magnetic fields at nuclei of nonmagnetic atoms is reported. Investigations by the Mössbauer effect show a distinct picture of hyperfine magnetic splitting of the ground and first excited states of the ^{119}Sn nuclei. (J.F.P.)

35425 DYNAMIC POLARIZATION OF DEUTERONS IN A LANTHANUM MAGNESIUM NITRATE CRYSTAL. Lushchikov, V. I.; Taran, Yu. V.; Frank, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Letters (USSR) (English Transl.), 1: 52-5(Apr. 15, 1965).

The dynamic polarization of deuterium nuclei was effected by the solid-effect method. The experiments were carried out at 37 Bc and at 1.4°K. The sample used was single-crystal double lanthanum-magnesium nitrate with part of the water of crystalization replaced by heavy water. (J.F.P.)

35426 STUDY OF THE GROUND AND EXCITED STATE OF THE Cl^{36} NUCLEUS. Lovas, Istvan (Central Research Inst. for Physics, Budapest). Magy. Fiz. Folyoirat, 12: 499-544(1964). (In Hungarian)

An investigation of the energy levels of ^{36}Cl is summarized. The description of ^{36}Cl on the basis of the shell model; derivation of the functions characterizing the mixed configuration; determination of the matrix elements, including those for the two-particle interaction; diagonalization of the energy matrix; selection of the N-N interaction operator; determination of the magnetic dipole and electric quadrupole moments of ^{36}Cl in the ground and excited states; and measurement of the angular correlation of the two gamma cascades in the $^{35}Cl-(n,\gamma\gamma')^{36}Cl$ reaction are covered. (D.C.W.)

35427 DISCUSSION OF FACTORS AFFECTING THE ABSOLUTE ACCURACY OF MÖSSBAUER f MEASUREMENTS. Housley, R. M. (Univ. of Washington, Seattle). Nucl. Instr. Methods, 35: 77-82(1965).

The possible influence on Mössbauer f measurements of self absorption and inelastic scattering in the source of reemission, inelastic scattering, and non-resonant nuclear absorption in the absorber are studied. (auth)

35428 NEUTRONS FROM THE DEUTERON BOMBARDMENT OF THICK TARGETS. Borchers, R. R.; Wood, R. M. (Univ. of Wisconsin, Madison). Nucl. Instr. Methods, 35: 138-40(1965). (TID-21441)

Neutron energy spectra resulting from the deuteron bombardment of thick targets of Ta, W, Pt, Au, Pb and Bi were obtained at incident deuteron energies between 8 and 14 Mev, and the yield of neutrons with energy greater than 1.5 Mev was calculated from the data. Angular distributions were measured at 10 and 13 Mev. Spectra from all the targets were very similar except for differing numbers of neutrons from carbon contamination on the surface of the targets. The neutron yield was found to increase rapidly with increasing deuteron energy and to decrease with increasing Z of the target material. (auth)

35429 A METHOD FOR THE MEASUREMENT OF TOTAL REACTION CROSS-SECTIONS FOR CHARGED PARTICLES. Bearpark, K.; Graham, W. R.; Jones, G. (Oxford Univ.). Nucl. Instr. Methods, 35: 235-41(Aug. 1965).

A technique is described for the determination of total reaction cross sections for charged particles by measuring the attenuation of the incident beam while traversing a thin target. By enclosing the target in a chamber which incorporates entry and exit ports to allow passage of the beam, most of the charged reaction products may be prevented from leaving the system. Absorption of a fraction of the incident beam due to nuclear reaction processes thereby results in a transfer of charge from the beam to the target system. Comparison of this charge with the total charge conveyed by the beam yields a direct determination of the attenuation and thence a measure of the reaction cross section of the target nuclei. The method is readily adaptable to a range of incident particles and energies and is particularly suited to accelerators yielding average beam currents greater than 10^{-4} μamp. Results are presented for copper for a range of proton energies from 8.78 to 11.2 Mev. At 9.85 Mev, a total reaction cross section of 790 ± 32 mb was obtained. Deuteron reaction cross sections for nickel were also measured, giving a value of 1460 ± 60 mb at 11 Mev. (auth)

35430 STUDIES IN THE LIQUID-DROP THEORY OF NUCLEAR FISSION. Nix, James Rayford; Swiatecki, Wladyslaw J. (Univ. of California, Berkeley). Nucl. Phys., 71: 1-94(1965).

In connection with nuclear fission the division of an

idealized charged drop is studied by means of a simplified version of the liquid-drop model. The degrees of freedom essential to a discussion of the division of a charged drop and the separation of the fragments to infinity are taken into account: a fragment-separation coordinate, a mass-asymmetry coordinate, a deformation coordinate for each fragment and rotational coordinates for each fragment. To specify fragment deformation, the fragments are represented by spheroids; a nucleus prior to division is represented by two overlapping spheroids. The hamiltonian for the idealized system consists of a sum of surface, Coulomb, and kinetic energies. A study of the saddle-point energies and shapes calculated in this two-spheroid approximation indicates that the approximation is most useful for discussing the fission of elements lighter than about radium. On the basis of this model, we calculate probability distributions for certain observable characteristics of fission fragments at infinity—their total translational kinetic energy, mass, individual excitation energies and individual angular momenta. This is done by applying standard static, dynamical and statistical methods to the hamiltonian for the system. The treatment, for the most part, is classical; quantum mechanics is considered only in the statistical-mechanics discussion of the behavior of the system near the saddle point. The predictions of the model are compared with existing experimental data for distributions in fragment mass and total translational kinetic energy for nuclei lighter than radium. The comparisons are made without the use of any adjustable parameters. The theory is capable of accounting for the magnitudes of the most probable values and widths of the experimental distributions, as well as some, but not all, finer details of the distributions. The dependence of the experimental distributions upon nuclear temperature, and the dependence of the experimental most probable kinetic energies upon the fissility parameter are also approximately reproduced by the calculations. (auth)

35431 EFFECTIVE NEUTRON AND PROTON INTERACTIONS IN ODD NUCLEI. Sasaki, Kiyoshi (Tokyo Univ.). Nucl. Phys., 71: 95-105(1965).

The properties of odd nuclei are analyzed on the basis of the j-j coupling shell model. For the sake of simplicity, the nuclei with one neutron (or hole) and one proton (or hole) in the outermost orbit are treated, and the validity of the angular momentum coupling rules for the ground states proposed by Brennan and Bernstein is investigated. Furthermore, the nature of the neutron-proton interaction is studied from the experimental data of the low-lying energy levels of odd nuclei. (auth)

35432 NEUTRON SPECTRUM FROM THE T + T REACTION. Wong, C.; Anderson, J. D.; McClure, J. W. (Univ. of California, Livermore). Nucl. Phys., 71: 106-12(1965). (UCRL-12318)

The neutron spectrum from the T + T reaction was measured by time-of-flight techniques using the swept and bunched 0.5-Mev tritium beam from the Cockcroft-Walton accelerator. The 90° neutron spectrum shows evidence for the following reaction modes: (a) direct breakup into 2 neutrons plus alpha particle ($T + T \rightarrow n + n + {}^4He$, Q = 11.33 Mev), the three-body breakup shape being modified by the presence of the neutron-neutron interaction; (b) sequential decay proceeding via the ^{5}He ground state; and (c) sequential decay proceeding via a broad ^{5}He excited state. The branching ratios for the T + T reaction at 90° are approximately 70% for (a), 20% for (b) and 10% for (c). The neutron group leading to the ^{5}He ground state, estimated width 0.74 ± 0.18 Mev, is isotropic to within an accuracy of ±10%. (auth)

35433 ANGULAR CORRELATIONS IN THE REACTIONS $C^{12}(He^3,\alpha\gamma)C^{11}$ AND $C^{12}(He^3,p\gamma)N^{14}$. Newton, J. O.; Blake, R. S.; Jacobs, D. J.; Schapira, J. P. (Univ. of Manchester, Eng.). Nucl. Phys., 71: 113-28(1965).

Particle-gamma angular correlations in which the particles were detected at 180° to the beam direction were studied. It is shown that the 2.00-Mev level in ^{11}C is likely to have spin $\frac{1}{2}$, though spins of $\frac{3}{2}$ or $\frac{5}{2}$ with restricted values of the quadrupole-dipole amplitude ratios are also allowed. The spin of the 5.10-Mev state in ^{14}N is shown to be 2 and the transition to the ground state to contain E1, M2, and E3 components. The amplitudes of the quadrupole and octupole components relative to that of the dipole are −0.18 ± 0.03 and 0.12 ± 0.04 respectively. The phase convention of Devons and Goldfarb is used. The correlation through the 4.91-Mev state of ^{14}N is found to be consistent with isotropy and the intensity of decays to the 0^+ state at 2.31-Mev and to the 3.95-Mev state are shown to be (0.4 ± 0.7) and (1.3 ± 1.0)% of that to the ground state. These results are consistent with the expected spin of zero for the 4.91-Mev state, spin one is unlikely but spin two is still possible. (auth)

35434 ANALYSIS OF NEUTRON-CAPTURE DATA IN THE RESONANCE REGION. Froehner, F. H.; Haddad, E. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Phys., 71: 129-56(1965). (GA-5137)

Methods for the hand calculation of resonance parameters from neutron capture data are presented. Shape analysis for the case of negligible multiple scattering and area analysis for the more general case $\Gamma_n \lesssim \Gamma_\gamma$ were worked out for non-fissile target nuclei. Special attention is given to the problems of multiple scattering, wing corrections, flux calibration, and instrumental resolution. A convenient method for error estimation in area analysis is also described. As a numerical example, the 7.9-ev resonance of ^{167}Er was treated by shape and area analysis. The result is $\Gamma_\gamma = 95 \pm 25$ mev, $2g\Gamma_n = 0.27 \pm 0.02$ Mev. (auth)

35435 POLARIZATION OF NEUTRONS FROM THE $^{12}C(d,n)^{13}N$ REACTION. Kelsey, C. A.; Mahajan, A. S. (Univ. of Wisconsin, Madison). Nucl. Phys., 71: 157-60 (1965). (COO-7-353)

The polarization of neutrons from the $^{12}C(d,n)^{13}N$ reaction was measured at various forward emission angles for deuteron energies between 4 and 7.5 Mev. Polarizations of the order of 0.30 were observed at several energies and angles. (auth)

35436 A HARTREE-FOCK TYPE CALCULATION OF THE SURFACE ENERGY OF SEMI-INFINITE NUCLEAR MATTER. McKellar, B. H. J.; Naqvi, M. A. (Univ. of Sydney). Nucl. Phys., 71: 161-91(1965).

The surface energy and surface thickness of semi-infinite nuclear matter are calculated within the framework of an independent particle model previously considered by Bethe and Bacher and by Swiatecki. A central Serber force with a velocity-dependent repulsive part is used for the two-nucleon interaction. The parameters of the force are adjusted to reproduce, approximately, low-energy two-nucleon scattering and the properties of nuclear matter. A generalized form of the virial theorem is used to find an analytic approximation to the functions which contribute to the surface energy integrals. The calculation gives a value of 41 Mev for the surface term in the mass formula and a surface thickness of 1.2 fm. The empirical values for these quantities are 18–20 Mev and 2.2 fm. It is suggested that this discrepancy would not be removed by a more realistic choice of the interaction and that it is therefore likely that clustering plays an important role in determining the surface properties of the semi-infinite system. (auth)

35437 THE LEVEL STRUCTURE OF ^{187}Re. Bisgard, K. Maack; Nielsen, L. J.; Stabell, E.; Oestergard, P. (Univ. of Aarhus, Denmark). Nucl. Phys., 71: 192-208 (1965).

In continuation of previous work selected details in the decay scheme of 24 h ^{187}W were studied using a six gap and a single gap beta ray spectrometer, gamma ray spectrometers, and various coincidence techniques. A formerly reported 36 kev transition is shown to feed a rotational state ($\frac{3}{2}^+$, $\frac{1}{2}$) at 582 kev built upon the state at 511 kev and not observed earlier. Branchings from the 582-kev level are seen. Based on this and additional evidence, two levels (582 and 880 kev) and five transitions (36, 71, 448, 582, 730, and 880 kev) were added to the level scheme proposed earlier. Possible implications for the interpretation of the 511-kev state are discussed. (auth)

35438 STUDY OF THE (d,n) REACTIONS AND THE TOTAL CROSS SECTIONS OF MEDIUM WEIGHT NUCLEI FOR 11.8 Mev DEUTERONS. Schmidt-Rohr, U.; Wagner, G. (Max-Planck-Institut fur Kernphysik, Heidelberg). Nucl. Phys., 71: 209-20(1965).

With a recoil proton spectrometer for fast neutrons the neutron spectra from the reactions ^{89}Y(d,n), Zr(d,n), and ^{93}Nb(d,n) were measured above 5 Mev neutron energy. These spectra show over a wide energy range a shape which is expected from an evaporation process. The comparison with previously measured activation cross sections shows that the (d,n) reaction proceeds by more than 95% via a compound nucleus process. The influence of reactions with emission of more than one particle on the proton and neutron spectra is discussed. We add a survey of the nuclear cross sections for 11.8 Mev deuterons on Zr and Nb. The resulting total reaction cross section is in agreement with the values predicted by Halbert from optical model calculations. (auth)

35439 MEASUREMENTS OF γ-RADIATION FROM Cl, K, V, Mn, AND Cu AFTER THERMAL NEUTRON CAPTURE. Rudolph, W.; Gersch, H. U. (Zentralinstitut fur Kernforschung, Rossendorf, Ger.). Nucl. Phys., 71: 221-7(1965). (In German)

Neutron capture γ rays from Cl, K, V, Mn, and Cu were measured by means of a magnetic Compton spectrometer. On the assumption that the high energetic γ rays are primary transitions from the capturing state, the corresponding levels of the product nuclei were determined. The majority of these levels can be safely identified with levels known from (d,p) reactions. (auth)

35440 TIME-OF-FLIGHT MEASUREMENTS OF NEUTRON SPECTRA FROM THE FISSION OF U^{235}, U^{238}, AND Pu^{239}. Barnard, E.; Ferguson, A. T. G.; McMurray, W. R.; Van Heerden, I. J. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 71: 228-40(1965).

The energy spectra in the range 100 kev to 9 Mev of the neutrons emitted in the fission of ^{238}U by 2.086 and 4.908 Mev incident neutrons were measured with a time-of-flight technique in conjunction with a multi-plate fission chamber. The experimental arrangement is described and possible errors discussed. The fission neutron spectra obtained from the slow neutron fission of ^{235}U and ^{239}Pu were also measured. These results and other published data are summarized and compared with the predictions of statistical theory. (auth)

35441 EXCITATION FUNCTIONS OF THE REACTIONS ^{58}Ni(n,2n)^{57}Ni, ^{65}Cu(n,2n)^{64}Cu, AND ^{64}Zn(n,2n)^{63}Zn IN THE ENERGY REGION FROM 12.6 TO 19.6 Mev. Paulsen, A.; Liskien, H. (EURATOM, Geel, Belg.). Nukleonik, 7: 117-20(Mar. 1965). (In German)

The absolute effective cross section for (n,2n) reactions on ^{58}Ni, ^{65}Cu, and ^{64}Zn were measured by means of the activation method in the energy range from 12.6 to 19.6 Mev with a standard deviation of ±7%. The half lives of ^{57}Ni, ^{64}Cu, and ^{63}Zn were determined. (tr-auth)

35442 DETERMINATION OF THE THERMAL AND EPITHERMAL FISSION YIELDS OF ^{136}Cs, ^{137}Cs, ^{140}Ba, ^{103}Ru, AND ^{106}Ru FROM ^{233}U AND ^{235}U SAMPLES. Balcarczyk, L.; Keratschev, P.; Lanzel, E. (Osterreichische Studiengesellschaft fur Atomenergie, Seibersdorf, Austria). Nukleonik, 7: 169-71(Apr. 1965). (In German)

An attempt was made to determine the fission yields of ^{137}Cs, ^{136}Cs, ^{140}Ba, ^{103}Ru, and ^{106}Ru from ^{233}U and ^{235}U samples for resonance and thermal neutrons. The individual fission yields could not be determined absolutely because of self-absorption of the uranium in the resonance region. Using ^{140}Ba as a reference standard, values were obtained for ^{136}Cs (^{235}U fission), ^{136}Cs, ^{103}Ru, and ^{106}Ru (^{233}U fission), which were found to deviate from previously obtained values. (L.B.S.)

35443 SCATTERING OF LOW-ENERGY K^--MESONS BY NUCLEI. Hetherington, J. H. (Univ. of Minnesota, Minneapolis); Condo, G. T.; Hill, R. D.; Lansford, R. M. Nuovo Cimento (10), 38: 7-11(July 1, 1965).

Nuclear scattering of K^- mesons of an average energy of 21 Mev was measured in G5 nuclear emulsion. An optical model calculation of the differential and total reaction cross sections was performed. Comparison of experiment and theory supports the conclusion reached at higher K^- meson energies that the nuclear optical potential is attractive. (auth)

35444 STUDIES OF (d,α) AND (d,d) REACTIONS ON ^{32}S. El-Behay, A. Z.; Farouk, M. A.; Nassef, M. H.; Zaloubovsky, I. I. (Atomic Energy Establishment, Cairo). Nuovo Cimento (10), 38: 52-9(July 1, 1965).

Angular distributions and excitation functions of α groups from the reaction ^{32}S(d,α)^{30}P leading to the ground and first excited states were studied in the deuteron energy range from 2.0 to 2.5 Mev. Angular distributions and excitation functions showed characteristic features of the compound nucleus mechanism. Further it was observed that the averaged intensity of α-groups obeyed the (2I + 1) rule. Angular distributions of the elastically scattered deuterons from ^{32}S nuclei did not show any remarkable deviation from the Rutherford law. (auth)

35445 MULTIPLE-PION PRODUCTION BY HIGH-ENERGY MUONS. Higashi, S. (Osaka City Univ.); Kitamura, T.; Mishima, Y.; Miyamoto, S.; Watase, Y.; Shibata, H. Nuovo Cimento (10), 38: 107-29(July 1, 1965).

By the use of two cloud chambers containing lead plates and iron plates, 133 events of the penetrating showers produced by muons in the energy range from about 10 Bev to a few hundreds of Bev were observed. The behaviors of the penetrating showers by muons were studied by comparing those estimated from the Heitler expression, the Kessler-Kessler expression and the DKMN expression which recently has been proposed by Daiyasu et al. The cross section for production of the showers at a depth of 50 mwe underground (from the top of the atmosphere) was found to be $(2.58 \pm 0.30) \times 10^{-31}$ cm^2/nucleon for lead plates. This value leads to the photonuclear interaction cross section $\sigma_{h\mu}$ of $(1.4 \pm 0.25) \times 10^{-28}$ cm^2/nucleon for the Heitler expression $(1.8 \pm 0.3) \times 10^{-29}$ cm^2/nucleon for the K.K. expression and $(3.8 \pm 0.65) \times 10^{-29}$ cm^2/nucleon and $(8.0 \pm 1.3) \cdot 10^{-29}$ cm^2/nucleon for the DKMN expressions obtained under the assumptions of a point-charge nucleon and of a finite-size nucleon respectively. The observed energy spectrum transferred to showers and the observed distribution of the deflection angles of their muons were compared with those which were expected from various theories. By comparison, it was found that the transferred energy spectrum is explained by the DKMN expression for a finite size nucleon, whereas the observed angular distribution fits the DKMN expression for a point-charge nucleon. In order to understand the results, four-dimensional momentum transfer values of showers were estimated and an existence of about 10% corelike interactions were discussed. (auth)

35446 ^{3}H AND ^{3}He EMITTED IN THE INTERACTIONS OF HIGH ENERGY PROTONS WITH LIGHT TARGETS. Kurtz, N. (Centre de Recherches Nucleaires, Strasbourg). Nuovo Cimento (10), 38: 141-8(July 1, 1965). (In French)

The number of ^{3}H and ^{3}He emitted in the interactions of protons of 25 to 30 Bev with light targets was calculated. The comparison of the results with the experimental curves of Fitch, Meyer, Piroué and of those of Schwarzschild and Zupancić shows a good accordance, which seems to justify the proposed interpretation. (auth)

35447 ACOUSTIC SATURATION OF NUCLEAR MAGNETIC RESONANCE LINES. Tewari, D. P.; Verma, G. S. (Univ. of Allahabad, India). Nuovo Cimento (10), 38: 197-205(July 1, 1965).

A study was made of the effect of acoustic power applied at twice the Larmor frequency on the individual nuclear magnetic resonance lines in the presence of radio-frequency power. When W_{u2}' ($W_{u\frac{1}{2}\to-\frac{1}{2}}$) is finite and other ultrasonic

transition probabilities are zero, one obtains the same acoustic saturation behavior for the central resonance line for the quadrupolar and the magnetic relaxations. For an arbitrary spin I, this expression was generalized. However, the central resonance line remains unaffected when ultrasonic transition probabilities other than $W_{\alpha\beta}^{\alpha}$ are finite separately. The effect of the acoustic power on the satellites for different cases is studied in great detail. Some of the satellites are affected and a few are unaffected. Some of the affected satellites show interesting behavior in the sense that, instead of the regular saturation behavior, enhancement effect and negative ratios of the population difference to its equilibrium value are obtained for higher values of U which is a measure of acoustic power. (auth)

35448 COMPOUND-NUCLEUS RADIATIVE CAPTURE CROSS-SECTION IN THE Mev ENERGY-RANGE AND NUCLEAR-LEVEL DENSITY. Benzi, V.; Bortolani, M. V. (CNEN, Bologna). Nuovo Cimento (10), 38: 216-33(July 1, 1965).

The neutron radiative capture cross sections in the Mev region for nuclei with neutron number $40 \leq N \leq 90$ are examined on the basis of the statistical model. An energy-dependence of the level density like $\rho(\overline{U}) \propto (A(\overline{U}+t))^{-2} \exp[2(a\overline{U})^{\frac{1}{2}}]$ is assumed. The a values obtained from the analysis are compared with those given by the analysis of the level density at binding excitation energy. (auth)

35449 ANALYSIS OF Σ^- ABSORPTION IN HELIUM. Bhatt, K. H. (Oak Ridge National Lab., Tenn.); Cohn, H. O.; Bugg, W. M. Nuovo Cimento (10), 38: 316-44 (July 1, 1965). (ORNL-P-879)

The momentum spectra of the lambda and the triton observed in the reaction Σ^- (at rest) + ^{4}He $\rightarrow \Lambda + n + {}^3$H are calculated assuming a phenomenological interaction hamiltonian for the basic process $\Sigma^- + p \rightarrow \Lambda + n$. Final-state interactions were neglected. Reasonable agreement is obtained for the Λ spectrum and also for the neutron spectrum. Marked deviation is obtained between the calculated and experimental triton spectrum indicating strongly the possibility of a Λn resonance at about 43 Mev in Λn system. (auth)

35450 ELASTIC SCATTERING OF LOW-ENERGY DEUTERONS BY ^{24}Mg, ^{25}Mg, ^{26}Mg, AND ^{27}Al. Bakr, M. H. S.; Omar, H. M.; Gontchar, V. Y. (Atomic Energy Establishment, Cairo). Nuovo Cimento (10), 38: 361-7 (July 1, 1965).

Measurements of excitation functions of elastically scattered deuterons by ^{24}Mg, ^{25}Mg, ^{26}Mg, and ^{27}Al in the energy range $E_{cm} = (0.8 - 2.2)$ Mev were carried out at an angle $\theta_{cm} = 152.5°$. Angular distributions were measured for 5 deuteron energies at angles in the range from 20 to 165° at steps of 5°. At these low energies significant deviations from Coulomb scattering were observed which differ appreciably for the different isotopes of magnesium. The results are compared with those of others at energies somewhat higher than our energy range. (auth)

35451 ON THE Λ-NUCLEUS OPTICAL POTENTIAL. Downs, B. W. (Univ. of Colorado, Boulder); Schultz, W.; Ram, B. Nuovo Cimento (10), 38: 652-4(July 1, 1965). (TID-21736)

The results of an investigation of the Λ-nucleus optical potential are reported. A complex potential is described with one unspecified parameter, the central depth of the real well. Comparison of total cross sections calculated from this potential with an experimental cross section leads to a rough estimate of this real depth. (J.F.P.)

35452 A NOTE ON THE ^{16}O(d,ALPHA)^{14}N REACTION. Pellegrini, F. (Universida, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 38: 655-8(July 1, 1965).

In view of the discrepancy in the configuration assignment, especially for even-parity states of ^{14}N, coming from the $(p)^2$ configuration, an experimental test is undertaken to analyze the experimental results of the ^{16}O(d,α)^{14}N reaction obtained at a deuteron bombarding energy of 15 Mev. This reaction was chosen because (d,α) reactions, in a pick-up process, favor those states having a large parentage based on the target nucleus in its ground state. (J.F.P.)

35453 GIANT DIPOLE GAMMA-DECAY FOLLOWING MU-MESON CAPTURE IN ^{12}C. Ueberall, H. (Catholic Univ. of America, Washington, D. C.). Nuovo Cimento (10), 38: 669-72(July 1, 1965).

In an attempt to verify the presence of the giant dipole mechanism in meson (μ) capture in a more direct experimental fashion, neutron spectra and γ rays should be studied near 10 Mev. An order-of-magnitude estimate of γ versus neutron decay widths is given to indicate whether an experimental search for these photons would be feasible. (J.F.P.)

35454 THE ENERGY SPECTRUM OF PROTONS DISCOVERED IN STARS PRODUCED BY PI-MESONS IN EMULSIONS. Kane, G. (Manhattan Coll., New York); O'Friel, Z. Nuovo Cimento (10), 38: 680-3(July 1, 1965).

An analysis of stars produced in a stack of nuclear emulsions by stopped mesons (π^-) is presented. A statistical analysis is made of the measured star prongs using an evaporation model including the contribution made by the evaporation of protons, deuterons, tritons, and alpha particles from heavy nuclei. In analyzing the data, contributions of all particles except protons were subtracted out. (J.F.P.)

35455 COHERENT INELASTIC SCATTERING FROM POLYCRYSTALLINE BERYLLIUM. Young, J. A.; Koppel, J. U. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Letters, 16: 235-7 (June 1, 1965). (GA-6238)

Previous experiments have shown considerable structural detail in the double differential scattering cross-section of beryllium powder. Calculations for beryllium are reported which confirm quantitatively the presence of this structure, and agree rather well with the averaged measurements. (M.O.W.)

35456 ON THE ELECTRIC CHARGE DISTRIBUTION IN EXCITED NUCLEAR STATES. Belyakov, V. A. (All-Union Scientific Inst. of Physics and Tech., and Radio-Technical Measurements, Moscow). Phys. Letters, 16: 279-80(June 1, 1965).

Results of the calculations of $\Delta\langle R^2\rangle$ (the difference between the mean square radii of the electric charge distribution for excited and ground states) are given. Isomeric states are treated in which transitions to ground states may be described as single particle ones. (M.O.W.)

35457 THE WIDTH OF THE 6.379 Mev STATE IN ^{29}Si. Retz-Schmidt, T. W.; Skorka, S. J.; Morgenstern, J.; Schmidt, H. (Universitat, Hamburg). Phys. Letters, 16: 280-2(June 1, 1965).

A discussion of the measurement of the width of the 6.4-Mev state in ^{29}Si is presented. Possible errors are considered. Using branching ratios from other considerations, transition strengths are determined from the measured total width. (M.O.W.)

35458 FLUCTUATIONS OF A NUCLEAR CROSS SECTION AROUND AN AVERAGE VALUE VARYING WITH ENERGY. Gadioli, E. (Universita, Milan). Phys. Letters, 16: 288-90(June 1, 1965).

A discussion is presented of the theory of fluctuations of cross sections when either the number of equally distributing channels or the invariance vary with energy. A limit to the case of statistical reactions is made. (M.O.W.)

35459 ON THE PROBABILITY DISTRIBUTION OF TOTAL CROSS SECTIONS. Bennewitz, J. (Universitat, Frankfurt am Main). Phys. Letters, 16: 290-1(June 1, 1965).

A Gaussian probability distribution for the total cross section of particles with arbitrary spins in the region of strongly overlapping resonances is derived. The invariance of this distribution is given by the fluctuating elastic cross section in forward direction. (M.O.W.)

35460 SEARCH FOR THE TETRANEUTRON VIA THE REACTION $\pi^- + {}^7Li \rightarrow {}^4n + {}^3He$. Cohen, R. C. (Columbia Univ., New York); Kanaris, A. D.; Margulies, S.; Rosen, J. L. Phys. Letters, 16: 292-3(June 1, 1965).

Presented is an investigation of two-body breakups following π^- absorption at rest in lithium. Measurements were sensitive to four neutron final-state interactions and particle-unstable tetraneutrons, as well as to particle-stable ones. (M.O.W.)

35461 THE γ-VIBRATIONAL BAND OF Er^{166}. Gallagher, C. J. Jr. (Columbia Univ., New York); Nielson, O. B; Sunyar, A. W. Phys. Letters, 16: 298-301(June 1, 1965).

Transition intensities following the decays of the ^{166}Ho isomer and of ^{166}Tm are measured. Results of an extensive series of angular correlation measurements, partly to establish spins and parities of the excited levels, and partly to measure possible M1 admixtures in the ΔI = 0 and 1 transitions from the K = 2 to the K = 0 band are presented. (M.O.W.)

35462 NEUTRON TOTAL CROSS SECTIONS AND INTERMEDIATE RESONANCES. Seth, K. K. (Northwestern Univ., Evanston, Ill.). Phys. Letters, 16: 306-8(June 1, 1965).

The average neutron total cross sections are measured for a number of nuclei in the energy range 3 to 650 kev with an energy resolution of about 8–10 kev. This data were analyzed for neutron strength functions. From this analysis it was concluded that the observed cross sections are almost entirely due to l = 0 and l = 1 interactions, and that for most nuclei contribution due to only one of the two angular momenta is important. Other observations made from the data are presented. (M.O.W.)

35463 DEUTERON-CARBON ELASTIC SCATTERING AT 650 Mev. Dutton, L. M. C. (Univ. of Birmingham, Eng.); Jafar, J. D.; Van Der Raay, H. B.; Ryan, D. C.; Stiegelmair, J. A.; Tandon, R. K.; Reading, J. F. Phys. Letters, 16: 331-3(June 1, 1965).

A calculation of deuteron-carbon elastic scattering at 650 Mev is compared with experimentally determined data. A 650-Mev deuteron beam incident on a carbon target was used. The scattered particles were detected by a telescope of three scintillation counters operated in triple coincidence. (M.O.W.)

35464 ON COLLECTIVE NONROTATIONAL STATES OF ODD-MASS DEFORMED NUCLEI. Soloviev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 16: 308-11(June 1, 1965).

A general study of nonrotational collective states of odd-mass deformed nuclei within the framework of the superfluid nuclear model, using the method of approximate second quantization, is presented. The interaction of quasi-particles with phonons describing the collective nonrotational states of even-even nuclei is considered. (M.O.W.)

35465 GIANT MAGNETIC QUADRUPOLE OSCILLATIONS IN NUCLEI. Deforest, T., Jr. (Stanford Univ., Calif.); Walecka, J. D.; Vanpraet, G.; Barber, W. C. Phys. Letters, 16: 311-14(June 1, 1965).

Calculations for the 2^-, T = 1 states in both ^{16}O and ^{12}C, using the particle-hole and random phase approximations reported previously, were carried out. A giant magnetic quadrupole state is reported to occur at 20.75 Mev in ^{12}C and 21.34 Mev in ^{16}O. An extensive study of these peaks is presented. (M.O.W.)

35466 TIME DEPENDENT PERTURBATIONS IN ANGULAR CORRELATIONS. Klyucharev, V. A. (Inst. of Physics and Tech., Kharkov). Phys. Letters, 16: 315-16(June 1, 1965).

Experiments with liquid sources have previously shown a rather strong perturbation of the correlation in some cases. An explanation is given for these perturbations. The integral attenuation factors as a function of time are considered. (M.O.W.)

35467 ON THE ANISOTROPY OF GAMMA RAYS FROM COBALT-60 NUCLEI, ALIGNED IN CERIUM MAGNESIUM NITRATE AT LOW TEMPERATURES. Kolac, M.; Svec, K. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Phys. Letters, 17: 111(July 1, 1965).

The anisotropy of gamma rays was calculated from cobalt-60 nuclei, aligned in cerium-magnesium nitrate without an external magnetic field. The anisotropy determined from experiment is lower than the prediction of calculations. (J.F.P.)

35468 ORIENTATION DEPENDENCE OF RUTHERFORD SCATTERING YIELDS IN SINGLE CRYSTALS. Boegh, E.; Uggerhoej, E. (Univ. of Aarhus, Denmark). Phys. Letters, 17: 116-18(July 1, 1965).

Measurements of wide-angle Rutherford scattering yields were initiated in order to develop a versatile method for studying the motion of charged particles in crystalline lattices. In Rutherford scattering there are two directions of motion, that of the incoming and that of the outgoing particle. If both directions are close to a major crystal direction, there is a complication. But if the two directions are well-separated, a study of both particle motions is possible. The results showed that the dip in yield around a string, a row of atoms, remains very pronounced during the slowing down of protons. This shows that the paths of the aligned particles are extremely stable. (J.F.P.)

35469 INELASTIC ELECTRON SCATTERING FROM ^{18}O. Vanpraet, G. J. (Stanford Univ., Calif.). Phys. Letters, 17: 120-1(July 1, 1965).

The results of measurements obtained by electron scattering on oxygen-18 are presented. Nuclear excitations including the giant resonance were observed in the energy spectrum of 69-Mev electrons inelastically scattered through 180°. The experiment was performed with the electron linear accelerator. Assuming that all of the protons make transitions leaving nitrogen-17 in the ground state, the photon energy can be inferred from the proton energy. (J.F.P.)

35470 ON THE EFFECTIVE TWO-BODY INTERACTION IN (n,p) REACTIONS ON CLOSED-SHELL NUCLEI. Schiffrer, G. (Universita, Catania, Italy). Phys. Letters, 17: 122-4(July 1, 1965).

A phenomenological method is suggested, based on the comparison of angular distributions for different residual levels in (n,p) reactions on closed-shell nuclei. In this case the levels of the residual nucleus form a closely spaced multiplet, deriving from a T = 1 particle-hole configuration. From the available data there is no conclusive evidence for a definite set of exchange parameters. (J.F.P.)

35471 ISOBARIC ANALOGUE STATES IN ^{139}La AND ^{141}Pr. Von Brentano, P.; Marquardt, N.; Wurm, J. P.; Zaidi, S. A. A. (Max-Planck-Institut fur Kernphysik, Heidelberg). Phys. Letters, 17: 124-6(July 1, 1965).

A systematic study of the isobaric analogs of the low-lying states in the nuclei with 83 neutrons was undertaken to investigate the nature of these highly excited states of the compound system. Measurements were made of the excitation functions of the differential cross section for the elastic scattering of protons from barium-138 and from cerium-140. The isobaric analogs of these states which are the parameters of the first five resonances in lanthanum-139 and in praseodymium-141 are also given. (J.F.P.)

35472 EFFECTIVE RESIDUAL NEUTRON-PROTON INTERACTION IN ^{50}Sc AND ^{56}Co. Ohnuma, H.; Sasaki, K. (Tokyo Univ.). Phys. Letters, 17: 126-9(July 1, 1965).

The neutron-proton interaction is investigated from the experimental data of the energy levels of scandium-50 and cobalt-56 by taking into account the configuration mixing for the neutron states. The results show that the experimental data of cobalt-56 and of scandium-50 can be explained on the whole with the same values of the param-

eters, and show that the neutron-proton interaction can be expressed mainly as Wigner force. (J.F.P.)

35473 THE NUCLEAR g-FACTOR OF THE 114 kev LEVEL IN ^{149}Pm. Bostroem, L.; Joshi, M. C.; Svensson, A. G. (Uppsala Univ.). Phys. Letters, 17: 131-2(July 1, 1965).

The g-factor of the first excited state of promethium-149 was measured by observing the γ-γ angular correlation pattern in an external magnetic field using a four-detector system. The two strong γ rays of this state were investigated by angular correlation measurements to determine which cascade has the larger anisotropy. All measurements were performed with sources consisting of neodymium chloride dissolved in water. Low-lying nuclear excited states in this isotope may be due to coupling of the odd proton and the vibrational core containing an even number of particles. (J.F.P.)

35474 A NOTE ON RESONANT BACKWARD PEAKS IN NUCLEAR REACTIONS. Newton, J. O. (Univ. of Manchester, Eng.). Phys. Letters, 17: 132-4(July 1, 1965).

An alternative interpretation of the backward peaks is proposed based on the statistical theory of the fluctuations in nuclear cross sections. The amplitude of the fluctuations relative to that of the average cross section at a given angle depends on the number N of independently fluctuating cross sections and on the fraction of the average cross section arising from direct interaction components. It is seen that larger fluctuations are expected at 0 and 180° rather than at other angles if the N value is greater than unity. It is concluded that the practice of associating isolated angular distributions which have forward or backward peaks with the presence of large direct interaction components is a dangerous one. (J.F.P.)

35475 SINGLE LEVEL DISTRIBUTION AND REPULSION EFFECT FOR EIGENVALUES OF RANDOM MATRICES. Cristofori, F.; Sona, P. G.; Tonolini, F. (CISE, Segrate, Italy and Universita, Milan). Phys. Letters, 17: 135-7(July 1, 1965).

The possibility is shown of obtaining both the repulsion effect and the exponential shape of the level density starting from a suitable distribution of the matrix elements. Also the method of Bronk is extended to the case of rectangular coordinates. It is found that although various shapes of distribution may be obtained in this way, it seems that there is not a simple criterion giving an exponential level density. (J.F.P.)

35476 NUCLEAR SPECTROSCOPY WITH ENERGY RESOLUTION OF A PART PER MILLION. McIntyre, J. A.; Randall, J. D. (Agricultural and Mechanical Univ., College Station, Tex.). Phys. Letters, 17: 137-9(July 1, 1965).

A technique is described for exciting nuclei to energies between 6 and 10 Mev which also has an energy resolution of a few electron-volts. The nuclear excitation is accomplished using electromagnetic radiation; such excitation then permits the determination of the fundamental electromagnetic transition rates of the levels excited. The excellent energy resolution of neutron-capture gamma rays was utilized in constructing the spectrometer for making these studies. The results show that, except for the smallest angles, there is no sign of a dip in the counting rate. (J.F.P.)

35477 CORE POLARIZATION EFFECT IN ^{209}Pb STUDIED IN THE ^{209}Tl → ^{209}Pb DECAY. Salling, P. (Universitet, Copenhagen). Phys. Letters, 17: 139-41 (July 1, 1965).

The study of the thallium-209 decay was undertaken with the aim of measuring the rate of the $s_{\frac{1}{2}} \rightarrow d_{\frac{5}{2}}$ E2 transition, the energy of which is 470 kev. This transition is of special interest because it provides a direct measure of the polarization of the closed core due to the odd neutron. The measurements were performed with the delayed coincidence setup. The effective E2 charges differ by a factor of about 2, a fact which seems to indicate that the core polarization effect depends strongly on the orbital of the odd particle. (J.F.P.)

35478 LEVEL STRUCTURE OF Ar^{37} FROM Ar^{36}(d,p)Ar^{37} REACTION. Rosner, Baruch; Schneid, Edward J. (Univ. of Pittsburgh). Phys. Rev., 139: B66-70(July 12, 1965).

The level structure of ^{37}Ar was investigated by bombarding ^{36}Ar gas enriched >99% with 15-Mev deuterons. Nineteen energy levels up to an excitation energy of 6.5 Mev were found. For eight of the levels angular distributions up to 145° were taken and l_n value and spectroscopic factors were determined. The 1.60-Mev level was found to be populated via $l_n = 3$ transition and the 2.50-, 3.55-, 4.49-, and 5.18-Mev levels via $l_n = 1$. From the j dependence of the $l_n = 1$ distributions, the spin values of these states were determined. The mean energies of the shell-model configurations were $1f_{\frac{1}{2}}$, 1.60 Mev; $2p_{\frac{3}{2}}$, 2.95 Mev; and $2p_{\frac{1}{2}}$, 5.04 Mev. The rate of change of the binding energy and the symmetry energy is discussed by comparing these results to the ^{41}Ar energy spectrum. (auth)

35479 LIFETIME OF THE 6,880-Mev LEVEL OF 28-Si. Swann, C. P. (Franklin Inst., Swarthmore, Pa.). Phys. Rev., 139: B271-3(July 26, 1965).

The Doppler-broadened 6.91-Mev radiation from the ^{19}F-$(p,\alpha\gamma)^{16}$O reaction was used to resonantly excite the 6.880-Mev level of ^{28}Si. The angular distribution of the scattered radiation is consistent only with a spin of 2. Since the resonance absorption is small, the lifetime was determined from the scattering results. A Li-drifted germanium detector was used to observe the incident spectral shape and from this the number of 6.880-Mev gamma rays per unit energy interval incident on the scatterer was determined. Assuming the ground-state branching to be between 70% and 90%, the mean life obtained is 1.93×10^{-13} sec $< \tau < 2.48 \times 10^{-13}$ sec. (auth)

35480 STUDY OF THE LEVEL STRUCTURE OF 60-Ni FROM (p,p′γ) ANGULAR DISTRIBUTIONS. Mohindra, R. K.; Van Patter, D. M. (Franklin Inst., Swarthmore, Pa.). Phys. Rev., 139: B274-81(July 26, 1965).

Measurements of ^{60}Ni(p,p′γ) angular distributions were made for incident proton energies of 5 to 7 Mev, using a 99.0% enriched ^{60}Ni target 3.9 mg/cm^2 thick. The γ-ray spectra become quite complex at 7 Mev, with transitions from most of the ^{60}Ni states up to 4-Mev excitation being present. The angular distributions remain essentially the same at various energies after correction for cascade feeding. The earlier tentative 0^+ assignment for the 2.29-Mev level now appears to be correct since the angular distribution of the 0.95-Mev γ ray is isotropic (±4%) and the (p,p′) cross section is in good agreement with Hauser-Feshbach theory. From its observed angular distribution, a 0.47-Mev cascade (2.63 → 2.16 Mev) was identified as a 3^+(M1,E2)2^+ transition essentially pure E2 in character. The angular distribution of the 1.79-Mev cascade from the 3.12-Mev level agrees with the prediction for a 2^+(M1,E2)2^+ transition with a mixing ratio of $\delta = 0.24 \pm 0.06$, in accord with a previous determination from the decay of ^{60}Cu. The present work indicates the following level scheme for ^{60}Ni: 1.33(2^+), 2.16(2^+), 2.29(0^+), 2.50(4^+), 2.63(3^+), and 3.12(2^+); 3.19(1) and 3.39(3 or 2) Mev. (auth)

35481 M/L- AND L/K-ORBITAL ELECTRON-CAPTURE RATIOS AND TRANSITION ENERGY IN 109-Cd DECAY. Moler, R. B.; Fink, R. W. (Univ. of Arkansas, Fayetteville). Phys. Rev., 139: B282-7(July 26, 1965).

A direct measurement of the M/L- and L/K-orbital electron-capture ratios in the decay of ^{109}Cd was carried out by using a gaseous radioactive source of ^{109}Cd$(CH_3)_2$ in a multiwire proportional counter with internal anticoincidence. The experiments yielded the following values of the orbital electron-capture probability ratios: $P_M/P_L = 0.232 \pm 0.020$, $P_{L+M+\ldots}/P_K = 0.332 \pm 0.015$, and $P_L/P_K = 0.237 \pm 0.015$. From the P_L/P_K value, the transition energy for capture to the 88-kev ($\frac{1}{2}^+$) state in ^{109}Ag was found to be $Q_{EC} = 80^{+5}_{-3}$ kev by application of the theory. The experimental M/L-capture ratio is in excellent agreement with the exchange-corrected theoretical result extrapolated from Bahcall (0.230) and with the theoretical results of Robinson. (auth)

35482 HIGH-RESOLUTION MEASUREMENTS OF INTERNAL CONVERSION LINES IN 183-W. Alexander,

Peter; Hager, Ralph S. (California Inst. of Tech., Pasadena). Phys. Rev., 139: B288-95(July 26, 1965). (CALT-63-8)

Multipole mixing ratios were determined for 30 gamma transitions observed in ^{183}W. These transitions were studied from the beta decay of 5.2-day ^{183}Ta using a high-resolution $\sqrt{2}\pi$ iron-free beta spectrometer. In all but seven cases, mixing ratios were determined from L-subshell internal-conversion intensities. These mixing ratios are compared with the recent theoretical predictions of Brockmeier et al. and Rowe, and provide a sensitive test of the nuclear models employed in these analyses. No evidence was found for the existence of two recently reported ^{183}W transitions. The existence of a new level in ^{183}W at 595.33 kev is proposed. (auth)

35483 EXCITED STATES OF ^{57}Fe POPULATED IN ^{57}Co DECAY. Kistner, O. C.; Sunyar, A. W. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 139: B295-9(July 26, 1965). (BNL-8948)

The gamma spectrum emitted in the decay of ^{57}Co was measured with a high-resolution Ge(Li) detector. In addition to the well-known gamma transitions of 136.4, 122.0, and 14.4 kev, the following weak transitions with energies given in kev (intensity per 10^5 ^{57}Co decays) were observed: 229.8 ± 1.0 (0.5), 339.7 ± 0.4 (4.2), 352.5 ± 0.4 (3.2), 366.8 ± 0.5 (0.6), 570.0 ± 0.4 (13.2), 692.1 ± 0.3 (137), and 706.4 ± 0.4 (5.7). A unique decay scheme is established on the basis of these energy measurements and gamma-gamma coincidence measurements employing NaI(Tl) scintillation detectors. The excited states of ^{57}Fe at 366.8 and 706.4 kev have spin and parity $3/2^-$ and $5/2^-$, respectively. The total internal-conversion coefficient for the 14-kev transition was measured by two independent methods: A gamma-gamma coincidence measurement in a calibrated geometry yielded a value of 9.0 ± 0.5. A measurement of the Mössbauer absorption cross section of 14-kev gamma rays in iron yielded a value of 8.9 ± 0.6. The good agreement between the results of these two independent methods resolves previously reported discrepancies. A more accurate determination of the half-life of the 14.4-kev first excited state by a gamma-gamma delayed-coincidence measurement gave a result of $(9.8 \pm 0.1) \times 10^{-8}$ sec. (auth)

35484 ^{7}Li QUADRUPOLE MOMENT. [PART] II. Present, R. D. (Univ. of Tennessee, Knoxville). Phys. Rev., 139: B300-3(July 26, 1965).

The recently determined electric quadrupole moment Q of the ^{7}Li nucleus disagrees with the predictions of current nuclear models. It is shown that the quadrupole and magnetic moments, together with the Gamow-Teller matrix element for the ^{7}Be → ^{7}Li (ground state) K capture, can be accounted for on the supermultiplet theory if the ad hoc wave function has a 65% admixture of the ^{2}P[3] states arising from the $1s^4 1p^2 2p$ (two) and $1s^4 1p^2 1f$ (one) configurations. Assuming equal configuration admixtures in both levels of the ground doublet term ($^2P_{3/2,1/2}$) the M1 and E2 transition strengths for quantum jumps between the ground state ($^2P_{3/2}$) and the first excited state ($^2P_{1/2}$) at 478 kev were calculated and found to agree with measured values of B (M1) and B (E2) within experimental error. The reduced E2 transition strength in emission is given by: $B(E2) \cong Q^2$. Pure LS coupling and exact partition symmetry are assumed. The proportion of the ground configuration can be substantially increased by including the $1s^3 1p^3 1d$ configuration in the mixture. (auth)

35485 EMISSION OF LONG-RANGE ALPHA PARTICLES IN THE FISSION OF 238-U WITH 17.5-Mev PROTONS. Atneosen, R. A.; Thomas, T. D.; Garvey, G. T. (Princeton Univ., N. J.). Phys. Rev., 139: B307-14 (July 26, 1965). (PPAD-2137-532)

The angular distribution of long-range alpha particles from ternary fission induced by 17.5-Mev protons incident on ^{238}U was measured with respect to both the fission-fragment axis and the beam direction. For alpha particles emitted perpendicularly to the fragment direction, the distributions are found to be independent of the azimuthal angle about the fission-fragment separation axis and independent of the angle with respect to the incident beam. The angular distribution of ternary-fission fragments is nearly identical to that of binary-fission fragments resulting from the same initial system of fissioning nuclei. These results are compatible with a mechanism in which nuclei undergoing ternary fission are quite similar to those undergoing binary fission. A comparison was made of the angular correlation of long-range alpha particles and fission fragments for proton-induced fission of ^{238}U and spontaneous fission of ^{252}Cf. When no differentiation is made between light and heavy fragments, the full widths at one-half maximum are 47 ± 12° and 33 ± 2°, respectively. Also the former system shows an unexpectedly large number of alpha particles emitted along the direction of the fragment separation axis. A ternary-to-binary fission ratio of $(2.7 \pm 0.6) \times 10^{-3}$ for ^{238}U plus 17.5-Mev protons was obtained from these measurements. The reported increase of the ternary-to-binary ratio at high excitation energies does not appear to depend in a simple way on the angular momentum of the initial compound nucleus. The binary-fission measurements yielded a fission cross section of 0.9 b and an angular anisotropy [W(0)/W(90°)] of 1.12. (auth)

35486 ANALYSIS OF SINGLE EXCITATIONS IN INELASTIC DEUTERON SCATTERING FROM 60-Ni, 92-Zr, AND 120-Sn NUCLEI. Jolly, R. K. (Univ. of Pittsburgh). Phys. Rev., 139: B318-30(July 26, 1965).

Inelastic scattering of 15-Mev deuterons from ^{60}Ni, ^{92}Zr, and ^{120}Sn nuclei was studied with adequate resolution to enable identification of almost all states of known spin and parity. Detailed angular distributions of deuteron groups corresponding to well-resolved states of these nuclei were measured and compared with distorted-wave Born approximation calculations for single excitations using a deformed optical-model potential. The theoretical predictions, including Coulomb excitation and for a complex coupling, are found to be quite successful for strongly excited states. The status of the Blair phase rule is discussed in the context of the aforesaid comparison. Spin and parity assignments are made for several new levels. Excitation energies, differential cross sections, and reduced transition probabilities were tabulated and compared with previously known values. (auth)

35487 REACTIONS ^{48}Ti(n,d)^{47}Sc, ^{16}O(n,d)^{15}N, ^{10}B(n,d)^{9}Be, AND ^{6}Li(n,d)^{5}He AT 14.4 Mev. Valkovic, V. (Institut Ruder Boskovic, Zagreb); Paic, G.; Slaus, I.; Thomas, P.; Cerineo, M.; Satchler, G. R. Phys. Rev., 139: B331-9 (July 26, 1965). (ORNL-P-1107)

The reactions ^{48}Ti(n,d)^{47}Sc, ^{16}O(n,d)^{15}N, ^{10}B(n,d)^{9}Be, and ^{6}Li(n,d)^{5}He were studied at 14.4 Mev. The absolute differential cross sections were analyzed using the distorted-wave method and assuming simple proton pickup. The effects of finite range, nonlocality, and radial cutoff were investigated. Good fits obtained for the reactions ^{16}O(n,d)^{15}N(g.s.), ^{10}B(n,d)^{9}Be(g.s.), and ^{10}B(n,d)^{9}Be(2.43 Mev) yield spectroscopic factors in close agreement with shell-model predictions. The shape of the angular distribution of the reaction ^{48}Ti(n,d)^{47}Sc is well explained, but a discrepancy in absolute magnitude of about a factor 4 is not yet understood. The agreement between theory and experiment for the reaction ^{6}Li(n,d)^{5}He(g.s.) is not satisfactory, and this may indicate the importance of other processes such as knock-on. (auth)

35488 NUCLEAR STRUCTURE STUDIES IN THE SELENIUM ISOTOPES WITH (d,p) AND (d,t) REACTIONS. Lin, E. K. (Univ. of Pittsburgh). Phys. Rev., 139: B340-53(July 26, 1965).

Levels of ^{77}Se, ^{78}Se, ^{79}Se, ^{81}Se, and ^{83}Se below about 5 Mev were investigated by observation of the energy and angular distributions of protons emitted in the (d,p) reactions at 15-Mev bombarding energy. Values of the transferred-neutron angular momenta and of the spectroscopic factors for levels were derived from the measurements by distorted-wave Born approximation calculations. The results for the degree of filling of shell-model states and locations of the centers of gravity of the shell-model levels were compared with the pairing theory of Kisslinger and Sorensen. It was found that the $5/2^-$, $5/2^-$, and $1/2^-$ subshells are less full and

the $g_{\frac{9}{2}}$ more full than expected. General agreement with pairing theory was obtained with the following parameters: $\epsilon^{+}_{\frac{9}{2}} = 3.0$ Mev, $\epsilon^{-}_{\frac{9}{2}} = 2.5$ Mev, $\epsilon^{-}_{\frac{9}{2}} = 1.0$ Mev, $\epsilon^{-}_{\frac{9}{2}} = 0$, and $\Delta = 1.65$ Mev from the odd-even mass difference. In ^{83}Se, an isomer of spin $\frac{1}{2}^{-}$ at 0.22 Mev was identified. Measurements on (d,t) reactions indicate that the $d_{\frac{5}{2}}$ subshell from the next (50-82) major shell is filling (~0.6 particle) in the Se nuclei, even though the lower (28-50) major shell is not completely full. (auth)

35489 (d,p-f) ANGULAR-CORRELATION STUDY OF FISSION-BARRIER TRANSITION STATES: ENERGY GAP OF A HIGHLY DEFORMED NUCLEUS. Britt, Harold C.; Gibbs, William R.; Griffin, James J.; Stokes, Richard H. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 139: B354-61(July 26, 1965). (LA-DC-6974)

The (d,p) reaction was used to produce fissioning nuclei with excitations from the fission threshold to 5 Mev above. The angular correlation of the fission fragments and the reaction protons was measured as a function of excitation. A theoretical correlation function is developed to permit values of the parameter K_0^2 to be derived from the observed angular anisotropy. For a ^{239}Pu target the values obtained for K_0^2 show a stepwise increase with increasing excitation. The largest step occurs at ~2.6 Mev above the fission threshold, and is interpreted as the beginning of quasiparticle excitations of the highly deformed fissioning nucleus. On this basis the pairing energy gap appears to be significantly increased for large nuclear deformations. Also, K_0^2 is observed to change at ~0.7 and ~1.6 Mev above threshold. It is suggested that these energies are the onset of collective vibrational transition states through which fission occurs. (auth)

35490 π^{-} CAPTURE BY ^{3}He AND THE TWO-NUCLEON CAPTURE MODEL. Divakaran, P. P. (Oxford Univ. and Univ. of Chicago). Phys. Rev., 139: B387-400(July 26, 1965).

The rates of capture of π^{-} mesons by ^{3}He leading to the final states d + n and p + n + n are calculated using a phenomenological two-nucleon hamiltonian for the capture interaction $\pi NN \rightarrow NN$, obtained previously by Eckstein from an analysis of the experimental data on the inverse process of one-pion production in nucleon-nucleon collisions. Both S- and P-orbit captures are considered and it is shown that P-orbit capture does not compete with the $P \rightarrow S$ radiative transition. The radiative capture rate W_γ (for final state $^{3}H + \gamma$) is computed in terms of the photoproduction amplitude of Chew, Goldberger, Low, and Nambu and is used to deduce the nucleonic absorption rate $W_{abs} = W_n + W_p$ from the ratio W_{abs}/W_γ measured experimentally. The agreement between calculation and experiment for W_{abs} is satisfactory. The conclusion is that the form of close pair correlations in nuclei is essentially the same as that for the free nucleon-nucleon interaction and is comparatively insensitive to the presence of other nucleons. (auth)

35491 LIFETIMES OF LIGHT HYPERFRAGMENTS. Kang, Y. W. (Ames Lab., Ames, Iowa); Kwak, N.; Schneps, J.; Smith, P. A. Phys. Rev., 139: B401-6(July 26, 1965). (IS-1054)

The lifetimes of light hyperfragments were studied making use of two stacks of nuclear-emulsion pellicles exposed to K^{-}-meson beams at the Bevatron and the Brookhaven A. G. S. In these two stacks 18 mesonic decays in flight were obtained from a total of 258 mesonic decays of hyperfragments. The values found for the lifetimes are the following: For $_{\Lambda}$He^{4}, $_{\Lambda}$He^{5}, and $_{\Lambda}$He^{4,5} events combined (8 in flight, 117 at rest), the value $\tau(_{\Lambda}He^{4,5}) = (2.2^{+}_{-}) \times 10^{-10}$ sec was obtained. By suitably apportioning the $_{\Lambda}$He^{4,5} events between $_{\Lambda}$He^{4} and $_{\Lambda}$He^{5} the values $\tau(_{\Lambda}He^{5}) = (1.8^{+}_{-}) \times 10^{-10}$ sec and $\tau(_{\Lambda}He^{4}) \geq 1.0 \times 10^{-10}$ sec were obtained. For $_{\Lambda}$H^{3}, using only two-body decays (3 in flight, 4 at rest), $\tau(_{\Lambda}H^{3}) = (0.8^{+}_{-}) \times 10^{-10}$ sec. Using both two-body and three-body decays (5 in flight, 18 at rest), $\tau(_{\Lambda}H^{3}) = (3.4^{+}_{-}) \times 10^{-10}$ sec. This value may be an overestimate owing to $_{\Lambda}$H^{4} contamination in the three-body $_{\Lambda}$H^{3} events. This point is discussed. For $_{\Lambda}$H^{4} $\tau(_{\Lambda}H^{4}) = (2.4^{+}_{-}) \times 10^{-10}$ sec using only three-body decays (4 in flight, 14 at rest), and $\tau(_{\Lambda}H^{4}) = (3.6^{+}_{-}) \times 10^{-10}$ sec using all $_{\Lambda}$H^{4} decays (5 in flight, 40 at rest). This last value may suffer from a bias against finding two-body $_{\Lambda}$H^{4} decays in flight which simulate small-angle scatterings under low magnifying power, although all scatterings were examined closely. The results are compared with theoretical estimates of hyperfragment lifetimes. (auth)

35492 ANOMALOUS ENERGY LOSSES OF PROTONS CHANNELED IN SINGLE-CRYSTAL GERMANIUM. Sattler, A. R. (Sandia Lab., Albuquerque, N. Mex.); Dearnaley, G. Phys. Rev. Letters, 15: 59-62(July 12, 1965).

The energy and angular dependence of protons channeled in germanium were studied with high angular resolution. The results show that under certain conditions a clearly resolved peak is observed at energies well above the normal energy-loss peak, indicating the existence of a channeling process having a specific energy loss. Also the energy loss of this peak is a function of crystallographic orientation. (J.F.P.)

35493 REACTION $He^{3}(p,n)3p$ AT E_p EQUALS 14.1 Mev. Anderson, J. D.; Wong, C.; McClure, J. W.; Pohl, B. A. (Univ. of California, Livermore). Phys. Rev. Letters, 15: 66-8(July 12, 1965). (UCRL-14213)

The reaction ^{3}He(p,n)3p is investigated for evidence of a strong three-nucleon interaction. The neutron spectrum from this reaction is measured from 3 to 90° in 15° steps with collimated 10m flight paths. The deuterium and helium-4 reactions were also run and used as a check and a background measurement respectively. The results showed no evidence of the existence of a strongly interacting three-nucleon system from the ^{3}He(p,n) reaction. (J.F.P.)

35494 OBSERVATION OF K-MESONIC X RAYS IN HELIUM. Burleson, G. R. (Argonne National Lab., Ill.); Cohen, D.; Lamb, R. C.; Michael, D. N.; Schluter, R. A.; White, T. O. Jr. Phys. Rev. Letters, 15: 70-2(July 12, 1965).

The observation of x rays from bound atomic states of mesons (K^{-}) and helium-4 nuclei are reported. A (6.7 ± 0.2)-kev x ray assumed to be an n = 3 to n = 2 transition (L_α) is definitely observed. There is also evidence for an n = 2 to n = 1 transition (K_α) of 34.7 ± 0.3 kev with an intensity of about 20% relative to the L_α line. (J.F.P.)

35495 COMMENTS ON EXPERIMENTS DETERMINING REPLACEMENT PROBABILITIES FOR ENERGETIC PRIMARY ATOMS IN CRYSTALS. Belogurov, V. N. (Latvian Academy of Sciences, U.S.S.R.). Phys. Status Solidi, 10: No. 1, K41-3(July 1, 1965).

A suggested experimental check of theoretical values of replacement probabilities for energetic primary atoms is a Mössbauer experiment with primary atoms excited by the capture of thermal neutrons. After the capture the excited nuclei emit γ rays at energies near the neutron capture energy and also γ rays without recoil. The coincidences of the two γ ray emissions gives information about the primary atoms with a previously known kinetic energy. (J.F.P.)

35496 APPLICATION OF THE METHOD OF ATTENDANT PARTICLES FOR COLLIMATING NEUTRONS D(d,n)3-He REACTION. Bordulya, A. P.; Sitko, S. P.; Strizhak, V. I. (Kiev State Univ.). Pribory i Tekhn. Eksperim., No. 3, 48-51(May-June 1965). (In Russian)

Electronic collimation of the neutrons of the reaction $D(d,n)^{3}He$ was carried out by a flow-fast coincidence scheme with a resolution of $2\tau = 2 \times 10^{-8}$ sec. With a selection coefficient of ~900, a solid angle of $4\pi/2000$ sterad of neutrons with energy 2.83 Mev was singled out. (tr-auth)

35497 DEVICES FOR MEASURING THE TIME OF NUCLEAR RELAXATION. Mazitov, R. K.; Ionov, V. I. (Kazan State Univ.). Pribory i Tekhn. Eksperim., No. 3, 142-51(May-June 1965). (In Russian)

Apparatus for the measurement of relaxation time of the nuclei ^{1}H, ^{2}D, ^{7}Li, ^{9}Be, ^{11}B, ^{19}F, ^{23}Na, ^{27}Al, ^{31}P, and ^{133}Cs by the spin-echo method is described. The potential possi-

bility of increasing the signal/noise ratio using a phase detector was realized by the use of an amplitude-time converter in the recording device and the following build-up of the signal on scaler circuits with an electromechanical counter. Such a realization of the recording apparatus of the relaxometer has an advantage over the boxcar integrator, in which the memory element serves as a capacitance especially for measuring long relaxation times. Besides this, this scheme allows the process of measurement to be partially automated and its accuracy to be increased. The measurement limits are: time T_2—from 10^{-4} to 10^{-1} sec (the upper boundary is limited in liquid self-diffusion); time T_1—from 10^{-4} sec to several seconds. The principal block diagrams of the apparatus are given. (tr-auth)

35498 THE ELASTIC SCATTERING OF 662-kev GAMMA RAYS. Narasimha Murty, V. A.; Lakshminarayana, V.; Jnanananda, S. (Andhra Univ., Waltair, India). Proc. Phys. Soc. (London), 85: 1075-80(June 1965).

Employing a 2.5 Curie ^{137}Cs source, total elastic scattering cross sections in Pb, Pt, Ta, Sn, and Zr were determined using a collimator geometry similar to that of Wilson at angles 20, 30, 45, 60, 75, and 90. The experimental results were compared with theoretical values obtained from the form-factor formula of Bethe and exact calculations of Brown et al. The experimental values in Pb, Pt, and Ta are in conformity with the theoretical values calculated from Brown et al. data. The experimental values in Sn and Zr show good agreement with form-factor values. (auth)

35499 INELASTIC SCATTERING OF LOW-ENERGY γ RAYS. Ramana Rao, P. V.; Rama Rao, J.; Lakshminarayana, V. (Andhra Univ., Waltair, India). Proc. Phys. Soc. (London), 85: 1081-4(June 1965).

The total atomic cross sections are determined in carbon, aluminum, and copper at photon energies of 145, 129, 100, and 84 kev by the transmission method in good geometry. The values of bound-electron inelastic scattering cross sections σ_b are extracted by subtracting the theoretical sum of photoelectric and coherent scattering cross sections from the total cross section. The values of σ_b are also calculated theoretically using the S(q, Z) values based on the Thomas-Fermi atomic charge distribution. The free-electron incoherent scattering cross sections σ_f are computed from the Klein–Nishina formula. Good agreement is obtained between theoretical and experimental ratios of σ_b/σ_f for carbon and aluminum at 145 kev and carbon at 129 kev. Deviations from experiment, increasing with atomic number and decreasing energy, are observed in all other cases and are ascribed to the systematic errors inherent in the Thomas-Fermi atomic charge distribution. (auth)

35500 A STUDY OF THE REACTION $^{10}B(^3He,\alpha)^9B$. Patterson, J. R.; Poate, J. M.; Titterton, E. W. (Australian National Univ., Canberra). Proc. Phys. Soc. (London), 85: 1085-92(June 1965).

Angular distributions and excitation functions for the $^{10}B(^3He,\alpha_0)^9B$ and $^{10}B(^3He,\alpha_1)^{9*}B$ (2.34 Mev) reactions were measured for ^3He bombarding energies between 2.0 and 10.0 Mev. Differential cross sections were determined. The angular distributions vary smoothly with energy and show a tendency for both forward and backward peaking. The α_0 angular distributions and the excitation function measured at 150° (lab.) indicate a strong resonance, with $\Gamma \sim 1$ Mev, at 5.8 Mev bombarding energy, corresponding to an excitation of 26.1 Mev in the ^{13}N system; but the α_1 data do not show a similar resonance. The occurrence of minor structure in the excitation functions with period of approximately 2 Mev may be evidence for compound nucleus fluctuations. The results suggest that the reaction proceeds mainly by direct processes with a competing resonance process at 5.8 Mev. (auth)

35501 THE 992-kev RESONANCE OF THE $^{27}Al(p,\gamma)$ REACTION. Ophel, T. R.; Osgood, D. R. (Australian National Univ., Canberra). Proc. Phys. Soc. (London), 85: 1093-6(June 1965).

The 992 kev resonance of the $^{27}Al(p,\gamma)$ reaction was reexamined with particular attention to the decay of the 7.80-Mev level of ^{28}Si. (auth)

35502 PRINCIPLES OF THE USE OF NUCLEAR RESONANCE IN GYROSCOPY. RESULTS IN NUCLEAR INDUCTION GYROMETRY. Hanuise, Guy. Rech. Aerospatiale, No. 104, 49-56(Jan.-Feb. 1965). (In French)

Fundamental equations are reviewed, and experimental techniques in nuclear magnetic resonance are discussed. (BBB)

35503 SYSTEMATICS OF THE LIGHTEST NUCLEI. Baz, A. I.; Goldanskii, V. I.; Zel'dovich, Ya. B. Usp. Fiz. Nauk, 85: 445-83(Mar. 1965). (In Russian)

The properties of the lightest nuclei, specifically of multineutrons and of the isotopes of H and He, are reviewed on the basis of papers published during the recent years up to Oct. 1, 1964. The consequences of the increase of mass for the physical properties are examined for the case of n = 2 (dineutron and diproton), A = 3, A = 4 (^4He, ^4H, ^4n), A = 5 (^5He), A = 8 (^8He), and for some of the heavier nuclei. The concept of the excited state is critically studied, considering the different types of instability of nuclear states; in this connection the importance of the lifetime of the excited state as a criterion for the classification of the nuclei is pointed out. The trineutron and the $T = 3/2$ level at A = 3 are mentioned; a section is also devoted to the heavier isotopes. 122 references. (TTT)

35504 THE STRUCTURE OF 3^- LEVEL OF SPHERICAL NUCLEI. Li, Yang-kuo. Wu Li Hsueh Pao, 21: 720-35(Apr. 1965). (In Chinese)

The structure of the negative-parity state is obtained for the system of N neutrons and Z protons outside of the closed shells of the nuclei, assuming a zero-order energy degeneracy. The structure consists of four different types of excitation. These types of excitation are coupled with one another, due to interaction, but retain their internal structure. Some examples for the case of breakdown of the zero-order energy degeneracy are studied. The result shows that the previous conclusion is correct for the lowest energy level of the 3^- state. (tr-auth)

35505 IZLUCHENIE ASIMMETRII I ANIZOTROPII DELENIYA YADER PRI OBLUCHENII URANA I VISMUTA PROTONAMI VYSOKIKH ENERGII. (Study of Nuclear Fission Asymmetry and Anisotropy During Irradiation of Uranium and Bismuth by High-Energy Protons). Obukhov, A. I. Thesis, Leningrad, [Radievyi Institut im V. G. Khlopina AN SSSR, 1963]. 136p.

A brief review of published data on mass and angular distribution of nuclear fission fragments, interactions of fast bombarding protons with nuclei, and relations between nuclear fission and particle evaporation is given. Experimental data is given on velocity transmission to nuclei, momentum and energy excitation, the number of fissions as a function of fragment range, angular distribution of fission fragments during irradiation of uranium by 460, 660, and 3000 Mev protons and bismuth by 660 Mev protons. Data on mass distribution of fission fragments of nuclei close to bismuth and plutonium nuclei and on calculations of nuclear angular moments following cascade interactions are analyzed. The results and additional data are also discussed. 180 references. (R.V.J.)

35506 BYULLETIN INFORMATSIONNOGO TSENTRA PO YADERNYM DANNYM. VYPUSK PERVYI. (Bulletin of the Information Center on Nuclear Data. Number 1). Leipunskii, A. I. Moscow, Atomizdat, 1964. 431p.

The data collected during 1963–1964 offer new information on parameters of elementary reactions of neutrons with nuclei, at energy range to ≤15 Mev, reactor constants, empiric formulas, integral parameters, and their characteristics used in reactor calculations and radiation protection. In addition to the measurements of nuclear data and their treatment, the bulletin includes data on the methods of calculating cross sections and treatment of the experimental data. (R.V.J.)

35507 STATISTICAL THEORIES OF SPECTRA: FLUCTUATIONS. Porter, Charles E., ed. A Collection of Reprints and Original Papers—With an Introductory Review by Charles E. Porter. Perspectives in Physics. A Series of Reprint Collections. New York, Academic Press, 1965. 589p. $5.95.

A collection of lectures, conference papers, and reports is presented. These present many theories and observations of atomic and nuclear spectral phenomena. (J.F.P.)

35508 OPTICAL MODEL OF THE ATOMIC NUCLEUS. Ulehla, Ivan; Gomolcak, Ladislav; Pluhar, Zdenek. Translated by Alter, G. New York, Academic Press, 1965. 147p. $7.75.

The theory of elastic scattering, inelastic scattering, and nuclear reactions is described, and discussions are presented on the application of the optical model, especially in the range of low energies up to 10 Mev, of medium energies between 10 and 100 Mev, and of high energies above 100 Mev. The theoretical motivation of the optical model is also discussed. (L.B.S.)

35509 CALCULATION MUON PENETRATION THROUGH SUBSTANCES TAKING INTO ACCOUNT FLUCTUATION LOSSES. Kalitkin, N. N.; Kuzmina, L. V.; Zatsepin, G. T. p.217-18 of International Conference on Cosmic Rays. Vol. 6. Bombay, Tata Institute of Fundamental Research, 1964.

The interaction constants of a meson (μ) with a substance can be determined by experiments on penetration of mesons (μ) through large thicknesses of substance. With a mathematically exact account of the fluctuation character of radiation and photonuclear losses of energy an accurate calculation of the meson (μ) passage can be made. In this calculation values are selected for agreement with experiment and the role of each type of loss is not separated. (J.F.P.)

35510 LOW-ENERGY PHYSICS. p.18-28 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Research is reported on: nuclear theory; optical model analysis of nucleon–nucleus interaction potentials; (γ,n) cross sections for ^{16}O and ^{141}Pr, as deduced by a "least-structure" solution between 10 and 65 Mev; analysis of d-d and d-p interactions using computer displays; comparisons of performances of calutrons and a 255° inhomogeneous-field electromagnetic separator for separating ^{139}La, ^{180}Ta, and ^{33}S; and production data for individual isotopes of Pu electromagnetically separated at ORNL. (T.F.H.)

35511 ISOTOPE SEPARATION IN THE STUDY OF NUCLEAR REACTIONS. Rudstam, G. (Centre Europeen de Recherches Nucleaires, Geneva). 9p. (CONF-578-11). ORINS

From Conference on the Physics of Electromagnetic Separation Methods. Orsay, France, July 1962.

The electromagnetic isotope separator at CERN ("RISC") was primarily designed for nuclear reactions studies. The separator is now being used for the study of the charge distribution resulting from the fission of uranium with 600 Mev and 24 Bev protons. So far, fission yields of iodine and xenon isotopes have been determined, and preliminary experiments with tellurium isotopes have started. Spallation experiments using lanthanum as target are carried out in parallel with the fission experiment. Also in this case the charge distribution will be determined. In these experiments a large number of radioactive isotopes of the elements of interest is formed, and it is impossible to resolve the complex decay curves obtained from a mixture of the isotopes. The isotope separator is therefore an indispensable tool allowing accurate cross section determinations to be made. (auth)

35512 APPLICATION OF SEPARATED ISOTOPES IN ISOTOPE SHIFT INVESTIGATIONS. Fischer, W. (Universitaet, Marburg, Ger.). 7p. (CONF-578-13). ORINS.

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

The application of separated isotopes for optical investigations of the isotope shift of spectral lines is shown. The isotope shift in the copper and silver spectrum was investigated. Separated isotopes were used because the isotope shift in the copper and silver spectrum is smaller than the line width attainable by interferential spectroscopy. Diagrams, charts, and graphs are included. (J.F.P.)

35513 RANGES IN THE kev-REGION OF HEAVY IONS DEDUCED FROM THE SHAPE OF α-PARTICLE SPECTRA. Domeij, B. (Nobel Inst. of Physics, Stockholm). 6p. (CONF-578-15). ORINS.

From Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962.

Accurate measurements of the detailed shape of distribution curves of particles of energies in the kev region have so far only been performed with the electrolytic peeling method. These measurements have shown that the range curves have a highly penetrating tail which means that the average range is considerably larger than the most probable range. It seemed interesting to check this important result with a method basically different from the peeling method. Since this method so far has been successfully applied only to Al, Au, and W targets, any other tracer method applicable to targets of other atomic numbers should be welcome. The Stockholm separator was used for shooting ^{222}Rn into different backings at ion energies in the region 1-250 kev. The shape of 5.486 Mev α line was studied with a semiconductor detector (resolution ~ 25 kev). Due to the fact that the stopping power for α particles can be considered constant for absorber thicknesses corresponding to the penetration depths of interest, the following expression is valid between the average range $\bar{R}$ of ions in the collector (at a certain ion energy), the center of gravity of the observed α spectrum E_c, the α-decay energy E_0) and the stopping power for the α particles $(dE/dx)_\alpha$ $E_c = E_0 - (dE/dx)_\alpha \cdot X_c$. The average penetration depth will be compared with the results obtained by the peeling technique. Preliminary experiments have confirmed the existence of a highly penetrating tail of the range curve. The half thickness of this tail is in fair agreement with the value obtained from the peeling method. (auth)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 34346, 34476, and 34847.

35514 (AD-425796) ELECTRON BEAM PLASMA SUBMILLIMETER GENERATION. Interim Engineering Report No. 2, August 1–November 30, 1963. Swartz, G. A.; Napoli, L. S. (RCA Labs., Radio Corp. of America, Princeton, N. J.). Dec. 1963. Contract AF33(657)-11069. 34p. $3.60(CFSTI).

The plasma coupler was constructed and experiments were carried out. R-f propagation was measured at 2, 3, and 4.7 kMc. Ionic sounds waves were observed on the plasma column of the demountable plasma coupler. It was shown that the existence of these instabilities enhances diffusion and lowers the plasma density. A grid placed in front of the discharge cathode could suppress or enhance the instability. The propagation velocity of the ionic sound waves was measured. (auth)

35515 (AD-608478) MAGNETO-IONIC MICROWAVE PROPAGATION EXPERIMENT. Technical Final Report, February 1–October 31, 1963. Gilardini, A. (Selenia S. P. A., Rome (Italy)). June 1964. Contract AF61(052)-668. 123p. (AFCRL-64-804). $4.00(CFSTI).

The characteristic equations for guided propagation along a static magnetic field in some transversally nonhomogeneous bounded and unbounded plasmas are derived by the method of nondestructive multiple reflections of a free wave, propagating according to the ray theory. A few specific cases (whistler, quasicircular longitudinal, very-slow waves) are considered in detail. Propagation in plasma slabs not aligned with the magnetic field is also discussed.

Experimental work included a preliminary investigation on the radiation pattern in a plasma of an electric dipole directed along the magnetic field. (auth)

35516 (AD-609482) RESEARCH ON ELECTROMAGNETIC PLASMA ACCELERATION. Final Report. Penfold, A. S.; Rosen, R. M. (Litton Systems, Inc., Beverly Hills, Calif. Space Sciences Lab.). June 1964. Contract AF49(638)-759. 494p. (AFOSR-64-1340). $4.95(CFSTI).

A final report on work covering four years of investigation is presented. Included are the following: (a) an experimental investigation of the acceleration of plasma toroids in a pulsed traveling wave device, (b) a theoretical investigation of the behavior of plasma in axially-symmetric magnetic fields, and (c) a detailed description of a C-W polyphase-driven traveling wave accelerator. Various ancillary techniques and apparatuses are described, including polyphase monitoring and control systems, an analog computer for axially-symmetric magnetic fields, and the C-W power sources. (auth)

35517 (AD-610009) ELECTRODYNAMICS IN A MAGNETO-IONIC ENVIRONMENT. Faust, William R. (Naval Research Lab., Washington, D. C.). Aug. 17, 1964. 17p. (NRL-6163) $1.00(CFSTI).

The equations of electromagnetic wave propagation in a magnetoionic environment are derived via the hydrodynamic equations of motion. This subject is presented to exhibit explicitly the approximations made in obtaining the equations of electrodynamics as applied to a plasma. An application of the results is made to derive a generalized equation of reciprocity for a plasma medium. A theoretical discussion of the plasma sheath surrounding a satellite shows that the satellite is charged to a potential of about 0.75 volt and that the sheath extends out about 2.5 cm. Such a sheath may affect the characteristics of an antenna. (auth)

35518 (AD-612632) A DIAGNOSTIC THEORY FOR CYLINDRICAL PLASMAS BASED ON THE BORN APPROXIMATION. Scientific Report No. 8 (Series 3). Ruquist, R. D. (Cruft Lab., Harvard Univ., Cambridge, Mass.). Dec. 15, 1964. Contract AF19(628)-2406. 52p. (AFCRL-65-87) $3.00(CFSTI).

The inverse scattering problem for a plane, axially polarized, electromagnetic wave incident upon a cylindrically symmetric inhomogeneous medium is solved under the Born approximation. The medium is characterized by its profile defined by the inhomogeneous Helmholtz equation. The diagnostic procedures determine the dependence of collision and plasma frequency on radial position in the plasma cylinder. (CFSTI)

35519 (AD-613037) MODAL ANALYSIS AND SYNTHESIS OF ELECTROMAGNETIC FIELDS. Felsen, Leopold B.; Marcuvitz, Nathan (Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.). Nov. 4, 1964. Contract AF19(604)-7499. 73p. (AFCRL-65-86; PIBMRI-1243-64) $3.00(CFSTI).

Modal methods are employed to represent the electromagnetic fields due to confined source distributions in an infinite, homogeneous, gyrotropic dielectric, with special emphasis on the case of a magnetoplasma. It is shown how the plane wave refractive index surfaces for the medium may be employed to impose the radiation condition, to locate stationary points in the integral representation, and to interpret the asymptotic field approximation in ray-optical terms. The field behavior in transition regions is emphasized. The results are then extended to plane stratified media, with the gyrotropic axis parallel to the direction of stratification. The discussion concludes with the treatment of simple diffraction problems wherein unidirectionally propagating surface waves may play a role. (auth)

35520 (LRP-15/65) MESURE DU VECTEUR DE PROPAGATION A L'INTERIEUR D'UN PLASMA CONFINE ET CHAUFFE PAR UN CHAMP DE HAUTE FREQUENCE. (Measurement of the Propagation Vector of the Interior of a Plasma Confined and Heated by a High-Frequency Field). Keller, R. (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland)). Mar. 1965. 27p. Dep.(mn).

A hydrogen plasma is confined and heated by means of a θ-coil which is fed by a high-frequency generator of 13 megawatt maximum power. The amplitude and phase of the magnetic field which penetrates the interior of the plasma are measured. The propagation vector is determined from the phase-amplitude relationship. An anomaly in the skin effect is observed in the case where the mean free path for electrons is larger than the skin depth. The behavior of the plasma during the heating process, ohmic dissipation, ionization, and the Poynting vector are discussed. (auth)

35521 (LPR-16-65) MESURE DES PROBABILITIES DE TRANSITION DE QUELQUES ELEMENTS IONISES: CONSTRUCTION DE L'EXPERIENCE. (Measurement of Transition Probabilities of Some Ionized Elements: Construction of the Experiment). Durand, J. (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland)). Apr. 1965. 23p. Dep.(mn).

An arc of 0.5 msec duration, the current of which can reach 10,000 amp., is described. The arc plasma is in thermal equilibrium: the temperature reaches 30,000 to 40,000°K. The density is of the order of 10^{16} cm^{-3}. The transition probabilities of the lines emitted by the arc are measured with the described spectroscopic device. Finally, the possibility is shown of measuring currents of 10^4 amp and more with a shunt, even if the frequency reaches several MHz. (auth)

35522 (LRP-17-65) PROFILS DE TEMPERATURE DANS UNE DECHARGE HAUTE FREQUENCE. (Temperature Profiles in a High-Frequency Discharge). Troyon, F.; Keller, R. (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland)). Apr. 1965. 24p. Dep.(mn).

A method for determining the electronic temperature of a plasma by the measure of the penetration of an alternating magnetic field is presented. Special attention is devoted to the conditions necessary to its validity. This method is applied to probe measurements made on a hydrogen plasma in a θ-pinch configuration. The consistency of the method is checked a posteriori. (auth)

35523 (MATT-289) EXTENSION OF SUYDAM'S CONDITION FOR PLASMA STABILITY TO INCLUDE FINITE LARMOR RADIUS EFFECTS. Stringer, T. E. (Princeton Univ., N. J. Plasma Physics Lab.). July 1964. Contract AT(30-1)-1238. 7p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI

It was previously shown that the conditions for stability of confined plasmas against the interchange mode, derived from the MHD equations, are eased when finite Larmor radius effects are included in the equations. This same analysis is applied to the equations describing the interchange mode in a cylindrical plasma. This gives the modified form of Suydam's criterion, where the critical value of the familiar Suydam's parameter is now a function of the ratio of ion Larmor radius to the scale length of the equilibrium pressure distribution. (M.O.W.)

35524 (N64-18436) RADIATION FROM UNIFORMLY ROTATING CHARGE DISTRIBUTION IN A PLASMA IN A MAGNETIC FIELD. Final Report, May 1, 1962–April 30, 1963. Gianzero, Stanley (Polytechnic Inst. of Brooklyn, N. Y.). 14p. (NASA-CR-53586). $1.60(CFSTI).

The problem of energy radiated in a plasma from a uniformly rotating charge distribution is of importance in connection with the generation of high-power microwave radiation. The dispersion properties of the plasma in a magnetic field may be used to confine the radiation either in the fundamental frequency of rotation of the charge or in a higher harmonic, in which case this radiation mechanism can be used as a frequency multiplier. A simple scheme for the plasma and the charge distribution is used to discuss the fundamental properties of the radiated spectrum. (auth)

35525 (NASA-TN-D-2862) EVALUATION OF TWO DIRECT-CURRENT METHODS OF PLASMA PRODUCTION

FOR USE IN MAGNETIC MIRROR EXPERIMENTS. Krawec, Roman; Prok, George M.; Swett, Clyde C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). June 1965. 27p. $2.00 (CFSTI)

An experimental investigation of two methods for producing a hydrogen plasma was conducted. One of the two methods was a hot-cathode discharge, while the other was a modified Philips-ionization-gage (PIG) discharge. The plasma properties investigated were ion diffusion, electron density, electron temperature, mean electron energy, plasma potential, and plasma current profile. The modified PIG discharge produced too small a plasma column to be satisfactory. It was possible with the other sources to form a 5-centimeter-diameter plasma column having a density of 8.5×10^{11} electrons per cubic centimeter at a pressure of 2 microns and a discharge supply of 15 amperes. The electron density is shown to be a function of current density and is compared with the results of other investigators. The configuration having the filament negative with respect to the plasma chamber minimized ion diffusion. The thermal electron temperatures as measured by the Langmuir probe were 2.3 to 8.4 electron volts; the temperatures of the primary electrons as measured by the spectrometer were 23 to 55 electron volts. (auth)

35526 (NRC-7884) ELECTRICAL CONDUCTIVITY OF INERT GASES-SEED COMBINATION IN SHOCK TUBES. Lau, J. (National Research Council of Canada, Ottawa (Ontario)). Dec. 1963. 57p. (MT-51)

The effect of seeding shock waves with alkali metal smoke is studied. The pressure, density, temperature ratio, electron density, and conductivity were calculated with a digital computer and tabulated for various combinations of gas and seeding material. A hydrogen-driven shock tube was constructed to measure the properties of the seeded gas behind the shock wave. Argon was chosen as the driven gas among the inert gases because of its well-known properties and its low speed of sound. (auth)

35527 (NYO-1480-22) STABILITY CRITERIA AND THE INITIAL VALUE PROBLEM FOR COLLISIONLESS, GUIDING CENTER PLASMA. Kadish, Abraham (Courant Inst. of Mathematical Sciences, New York Univ., N. Y.). Apr. 1, 1965. Contract AT(30-1)-1480. 71p. (MF-45). Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Employing the system of integro-differential equations which govern a plasma in the guiding center limit, stability criteria are found for infinite, homogeneous, collisionless, guiding center plasma. A one-dimensional fundamental solution is derived for the linearized system, and a well-posedness theorem is proved for the corresponding initial value problem. (auth)

35528 (UCRL-13147(Pt.1)) THERMAL STRESSES DURING RAPID TRANSIENT HEATING. FINAL REPORT. PART 1. HEATING CHARACTERISTICS OF A PLASMA GENERATOR. Frisch, J.; Giedt, W. H. (California Univ., Berkeley. Inst. of Engineering Research). Feb. 1965. Contract W-7405-eng-48. 66p. Dep.(mn); $3.00(cy), 2 (mn) CFSTI.

The performance characteristics of a d-c arc plasma generator were experimentally investigated. Relationships between the necessary defining parameters were established. Independent parameters considered were voltage, power input, nitrogen gas flow rate, nozzle diameter, and electrode geometry. To determine the properties of the plasma stream, a method based on the energy balances made with a calorimeter was developed. The performance of the plasma generator was further investigated by applying theoretical background gained from a study of the nature of the electric arc. This investigation was necessary for a greater comprehension of the phenomena involved in the operation of the plasma generator. Within its operating range, the plasma generator was found to perform reliably. This operating range permits the use of from 40 to 92 kilowatts of electrical power. The ranges of currents and voltages were 340 to 670 amperes and 99 to 190 volts, respectively. Operating at overall efficiencies of from 25% to 75%, the plasma generator delivered an enthalpy rate of from 11.4 to 55.8 kilowatts to the plasma stream. The resulting plasma gas enthalpies ranged from 1370 to 3300 Btu/lb with the corresponding temperatures ranging from 4340 to 9020°F. (auth)

35529 (FTD-MT-64-284(p.143-50)) PROPAGATION OF ELECTROMAGNETIC WAVES THROUGH AN INHOMOGENEOUS PLASMA. Kamenev, I. V.; Pogosyan, V. A. Translated from Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 1, (Jan.-Feb. 1964).

Propagation of electromagnetic waves through inhomogeneous media in free space was described in previous works, but the problem of wave propagation was solved only in the assumption of plasma homogeneity along the waveguide axis. In real situations, this assumption frequently is not fulfilled. The positive column of a gas discharge, used as a plasma medium, usually has laminar structure. The waveguide propagation of electromagnetic waves through inhomogeneous plasma is considered. (auth)

35530 (FTD-TT-65-63) LOW-TEMPERATURE PLASMA GENERATORS. Khristianovich, S. A.; Zhukov, M. Yu. Translated from Vestn. Akad. Nauk SSSR, No. 6, 21-5(1964). 10p. $1.00(CFSTI).

Research and development on low-temperature plasma generators (plasmatrons) is reviewed; studies are being carried out especially in the fields of high-speed aerodynamics, shock waves, MHD, and power-engineering equipment. In plasmatrons, heating of gases to temperatures of 6000°K using a-c or d-c electric arcs is performed. An example of a simple design of a plasmatron, using eddy gas stabilization of the electric arc, is discussed. Processes involved in shunting of the arc are considered. The current-voltage characteristics in a plasmatron chamber are described, using an approximation theory. Applications of the plasmatron are considered. (M.J.T.)

35531 ON THE SPATIAL EQUILIBRIUM OF PLASMA CYLINDER IN LONGITUDINAL STATIONARY MAGNETIC FIELD. Shafranov, V. D. At. Energ. (USSR), 18: 443-6 (May 1965). (In Russian)

Conditions of plasma equilibrium in toroidal figure-eight shape chambers were determined for the case in which the plasma containment time exceeds the time of magnetic field penetration through the solenoid winding. In such cases, a part of magnetic field power lines penetrate the solenoid winding by closing the circuit outside the field. Hence, the radius of the cross section of outer extreme toroidal magnetic surface, which is totally distributed in the chamber, becomes smaller than the radius of the solenoid cross section. With plasma pressure exceeding a certain critical value the toroidal magnetic surfaces are absent and containment of plasma becomes impossible. (tr-auth)

35532 DETERMINATION OF PLASMA PARAMETERS BY MEANS OF MULTIPLE-WAVE RADIO-INTERFEROMETER. Balakhanov, V. Ya.; Rusanov, V. D.; Striganov, A. R. At. Energ. (USSR), 18: 515-16(May 1965). (In Russian)

An attempt was made to measure electron density in plasma by means of multiwave Fabry-Perot interferometer. The installation with a stationary cylindrical plasma consisting of glass vacuum chamber filled with hydrogen to 10^{-3} torr pressure was used in the experiment. A high frequency discharge in a 700 oersted longitudinal magnetic field was used for developing plasma cylinder 3.5 cm in diameter. The experimental installation is described, and the results of probe measurements and measurements carried out with the Fabry-Perot multiwave interferometer are tabulated. (R.V.J.)

35533 DISCHARGES IN POTASSIUM SEEDED ARGON AT ELEVATED TEMPERATURES. Sakuntala, M. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Brit. J. Appl. Phys., 16: 821-32(June 1965).

The variation of the plasma current with the voltage applied between stainless steel electrodes, 0.1 to 1 cm apart, was measured in argon at 1 atmosphere containing potassium vapor at pressures of 0.4 to 4 torr, for tem-

peratures between 1000 and 1200°K. It was found that as the electrode voltage was gradually raised from zero, the current, originally of the order 10^{-6} A and below 0.1 V independent of the voltage, increased first slowly and later more rapidly with the voltage. At about 20 V, corresponding to a current of order 10 mA, a sudden transition into a hot cathode arc occurred while the current rose to several amperes. Measurements of the potential distribution in the hot plasma by means of electrostatic probes showed the presence of a relatively large cathode fall, of a smaller anode fall and of a region of constant potential gradient between the two fall regions. An analysis of the observations revealed that thermionic emission from the potassium covered electrodes, thermal ionization of potassium vapor, space charge fields, and production of positive ions by electron collisions were the dominant features of this discharge plasma. A relation was derived for the transition to take place from the low to the high current mode assuming space charge neutralization to be the controlling factor. (auth)

35534 KLYSTRON-TYPE OSCILLATIONS IN AN ALKALI PLASMA. Allen, J. E. (Cambridge Univ., Eng.). Brit. J. Appl. Phys., 16: 909-10(June 1965).

It is suggested that some recently observed oscillations in alkali plasmas can be explained in terms of a klystron-like behavior. (auth)

35535 COMPARISON OF PROBE AND MICROWAVE MEASUREMENTS OF ELECTRON DENSITY IN PLASMATIC CYLINDER. Musil, J.; Datlov, J.; Zacek, F. (Inst. of Plasma Physics, Czechoslovak Academy of Sciences, Prague). Czech. J. Phys., 15: 391-8(1965).

A comparison is made of the measurement of the electron density of a plasma cylinder in a weak magnetic field (radius of cyclotron rotation of ions r_{Hi} is larger than radius of probe a) parallel to the axis of the plasma by means of a cylindrical Langmuir probe and a microwave interferometer in the X band. A Langmuir probe is used to measure the electron density distribution across the cross-section of the plasma cylinder. The measured density distribution is used to determine the mean electron density over the cylinder cross-section. This mean electron density is compared with the density found with a microwave interferometer. In evaluating the measurements the concentration of the microwave energy through the antennas of the interferometer in the cross-section of the plasma cylinder is considered. The difference of the mean electron density found by the microwave method from the mean density found by the probe method was in the least favorable case 30%. In conclusion, a comparison is given of the probe and microwave measurements of the plasma density in a stronger magnetic field, when $r_{Hi} \geq a$. (auth)

35536 VERIFICATION OF MICROWAVE METHOD OF MEASURING SMALL CHANGES IN CONCENTRATION OF ELECTRONS IN STRIATED PLASMA. Pilar, J.; Sicha, M. (Charles Univ., Prague). Czech. J. Phys., 15: 399-406 (1965).

The application of high-frequency resonance methods of measuring the concentration of electrons to measurements in the striated positive column of a d-c glow discharge was previously treated. Some conclusions of the method have been experimentally verified in a frequency band of 1.8 kMHz. A further, more detailed experimental verification is carried out on shorter wave lengths, in a frequency band of 3 kMHz. (auth)

35537 PARTICLE DISTRIBUTION IN A CYLINDRICAL POTENTIAL FIELD. Moskalenko, A. M. (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR)(English Transl.), 4: 798-804(1964).

Translated from Geomagnetizm i Aeronomiya, 4: 1026-(1964).

Expressions for the concentration and flux of particles in a rarefield gas in a cylindrical field are obtained and analyzed. Particle absorption at the surface of a body is taken into account. (auth)

35538 THE MAGNETOIONIC THEORY AT HYDROMAGNETIC FREQUENCIES. Seshadri, S. R. (Sylvania Electronic Products, Inc., Waltham, Mass.). J. Atmospheric and Terrest. Phys., 27: 617-34(May 1965).

The characteristics of a plane wave propagating in a two component lossless plasma are studied using the approach of the magnetoionic theory for all directions of propagation with respect to that of the static magnetic field and for frequencies ranging from hydromagnetic to radio frequencies. The propagation ranges of the two modes are obtained by a variant of the well-known CMA diagram and the advantages of this new representation are outlined. In the close neighborhood of the directions parallel and perpendicular to the static magnetic field, the dispersion is found to vary rapidly. The electron gyromagnetic and the plasma resonances as well as the cut-off frequency of the high frequency branch of the ordinary electromagnetic mode show discontinuous variations in the close neighborhood of the direction of the static magnetic field. An interesting result of this investigation is that the so-called ion cyclotron resonance frequency is practically independent of the direction of propagation except in the very close neighborhood of the direction perpendicular to that of the static magnetic field. Frequency and spatial dispersion relations are presented for some typical parameters. (auth)

35539 MICROWAVE ABSORPTION BY A PLASMA SLAB. Takeda, Susumu; Minami, Kazuo; Masumi, Motoshi (Nagoya Univ., Japan). J. Phys. Soc. Japan, 20: 845-50 (May 1965).

The reflected power of a microwave is experimentally examined, when the wave is incident on a plasma slab with a metal wall at its rear side. From the reflected power, it is found that the power is dissipated most effectively under a certain condition. This condition calculated with approximations is confirmed to be satisfactory in comparison with the experimental results. An afterglow plasma produced by repeated pulses of high DC voltage in a part of an X-band rectangular waveguide is used as a plasma slab with electrons uniformly distributed. The collision frequency of electrons with ions which predominates over that with neutral atoms in the afterglow plasma during the time of interest is determined at the maximum absorption. The collision frequency found is slightly higher than that predicted by theory and fairly agrees with the result previously measured by a different microwave method. The electron temperature can be estimated from the reflected power at the maximum absorption. (auth)

35540 PLASMA RESONANCES OF POSITIVE COLUMN IN A MAGNETIC FIELD. Kojima, Shoji (Tokyo Univ.); Hagiwara, Shigeo; Ogihara, Hiroyasu. J. Phys. Soc. Japan, 20: 851-4(May 1965).

By applying a weak magnetic field along the axis of positive column of discharge the resonance absorption was observed. The resonance due to surface wave of dipole mode showed splitting. However, the resonance due to dipole oscillation and the resonance due to longitudinal plasma wave did not change remarkably. An explanation for those phenomena was given. (auth)

35541 ENHANCEMENT OF CYCLOTRON HARMONICS IN A HOMOGENEOUS MAGNETOPLASMA. Sugihara, Ryo (Nagoya Univ., Japan). J. Phys. Soc. Japan, 20: 855-9 (May 1965).

A theoretical investigation is made of the radiation from a point charge e gyrating in a plane almost perpendicular to a magnetic field. The perpendicular component of the velocity, v, of the charge is assumed to be non-relativistic but much larger than the thermal velocity v_T, $\ln v/v_T \gg 1$. Under the conditions $|\epsilon_1| \gg (sv_T/v)^{4/3 \cdot s-2}$, $\epsilon_3 \gg (v_T/sv)$ and $\omega_0^2 < \omega^2 = (s\omega_H)^2 < \omega_0^2 + \omega_H^2$, the intensity of the s-th harmonic is enhanced and given by $(2e^2\omega_c^2/\pi sv\sqrt{|\epsilon_1\epsilon_3|}) \ln (v/v_T)$. Here ω_0 and ω_H are the plasma frequency and the electron cyclotron frequency, respectively, s is a positive integer larger than unity and $\epsilon_1 = 1 - \omega_0^2/(\omega_c^2 - \omega_H^2)$, $\epsilon_3 = 1 - \omega_0^2/\omega^2$. A harmonic structure appears when ω_H or ω_0 is changed. It is pointed out that some features of the experiments on cyclotron harmonic waves can be explained by this theory. (auth)

35542 LIGHT SPARK IN A MAGNETIC FIELD. Askar'yan, G. A.; Rabinovich, M. S.; Savchenko, M. M.; Smirnova, A. D. (Lebedev Inst. of Physics, Moscow). JETP Letters (USSR) (English Transl.), 1: 5-8(Apr. 1, 1965).

The first results of an investigation of a spark in a magnetic field are described. This can be used both to study the development of the plasmoid of the spark, and to study the interaction between the spark plasma and the magnetic fields. In the experiments an ordinary Q-switched laser was used. (J.F.P.)

35543 EXCITATION AND THERMALIZATION OF ELECTRON PLASMA WAVES IN A STRONG-CURRENT GAS DISCHARGE. Sukhomlin, E. A.; Reva, N. I.; Suprunenko, V. A.; Tolok, V. T. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). JETP Letters (USSR) (English Transl.), 1: 68-71(Apr. 15, 1965).

Analogous processes to the two-stream instabilities to heat plasmas are investigated in a strong-current gas discharge upon thermalization of plasma waves excited by electrons. The experiments were carried out with a linear strong-current gas discharge in hydrogen, stabilized by a longitudinal magnetic field. Effective heating of electrons by thermalization of plasma waves in a gas discharge was shown. (J.F.P.)

35544 ACCELERATION OF PARTICLES BY THE EDGE FIELD OF A MOVING PLASMA POINT THAT INTENSIFIES AN ELECTRIC FIELD. Askar'yan, G. A. (Inst. of Physics, Academy of Sciences, USSR). JETP Letters (USSR) (English Transl.), 1: 97-9(May 1, 1965).

It is shown that by means of a moving inhomogeneity, which intensifies a quasistatic electric field, it is possible, under certain conditions, to obtain acceleration equivalent to potentials exceeding by many times the employed potential difference. (J.F.P.)

35545 TRANSPORT PROCESSES IN ARC PLASMA. Vukanovic, Vladimir (Fizikai-Kemiai Intezet, Belgrade). Magy. Kem. Folyoirat, 71: 82-8(Feb. 1965). (In Hungarian)

A new model was developed for illustrating the distribution of particles within the plasma. It stipulates an equilibrium between the effects of the electric field acting perpendicularly with respect to the direction of flow and the results of ambipolar diffusion. The model provides an explanation concerning the effects of materials carried into the plasma. Particle transport along the axis of the arc involves the action of the electric field, the concentration-gradient controlled diffusion, thermal diffusion, ambipolar diffusion and convection. Thermal diffusion plays only a minor role in these processes. Removal of particles from the plasma is assumed to be due to diffusion, rather than convection. Migration or transport in the direction of flow is affected by the temperature and intensity gradients; at high temperatures the plasma is fully ionized while at the low-temperature region it is neutral. The isotropic effect in the direction of flow has not yet been sufficiently well studied in an arc plasma. Effects in the radial direction are connected with duration of the stay of particles in the plasma. In a d-c arc, a stationary particle distribution is obtained; it is affected by the degree of ionization, the particle concentration and their volume. Outward migration of tracer element is influenced by the additives. The phenomenon is similar to the enrichment of ions on the cathode. (28 references). (TTT)

35546 ANNULAR ION SOURCE OF THE DUOPLASMATRON TYPE. Becherer, R.; Bariaud, A.; Prevot, F. (CEA, Fontenay-aux-Roses, France). Nucl. Instr. Methods, 35: 229-34(Aug. 1965). (In French)

An annular extension of the duoplasmatron ion source was built with a mean diameter of 25 cm. The feasibility and the location of such an annular discharge depends on the shape of the magnetic field between the intermediate electrode and the anode. The uniformity of the discharge is related to that of the magnetic field along the ring. An ion beam of 500 mamp was extracted and is limited to this value only by the pumping speed of the apparatus. Finally, the possibility of using a cold cathode instead of the hot cathode was established. (auth)

35547 MEASUREMENTS ON IONIC WAVES AMPLIFIED BY COLLECTIVE BEHAVIOUR IN AN ALKALI PLASMA. Enriques, L.; Righetti, G. B.; Magistrelli, F.; Boschi, A. (EURATOM-CNEN, Rome). Nuovo Cimento (10), 38: 26-45(July 1, 1965).

An experiment on ionic waves sustained by collective amplification in a uniform, steady plasma, free of electric field, is described. The plasma is obtained by contact ionization of cesium or potassium vapors on the surface of two coaxial tantalum cylinders kept at a temperature of about 2600°K. The application of a variable d-c voltage between the two cylinders gives rise to an unstable velocity distribution function which can be varied at will. Predictions are given for the dependence of the frequency of the oscillations on the applied voltage, on the ionic mass and on the plasma density. Experimental results are consistent with the predictions if the wavelength is equal to four times the distance between electrodes. A possible explanation of this fact is also suggested. (auth)

35548 THE PINCH EFFECT IN A LOW PRESSURE DISCHARGE. Caruso, A.; Giupponi, P. (CNEN, Rome). Nuovo Cimento (10), 38: 255-69(July 1, 1965).

The theory of a low-pressure discharge is given taking into account the effect of the magnetic field produced by the discharge itself; this is done using a simplified model which neglects the dispersion in velocity of the ions and which assumes a hydrostatic equilibrium for the electrons. (auth)

35549 SELF-FIELD CORRECTION IN A BROWNIAN PLASMA. Janos, W. A. (North American Aviation, Inc., Downey, Calif.). Nuovo Cimento (10), 38: 536-46(July 1 1965).

Electron kinetic reaction to electromagnetic propagation in a three-fluid plasma is studied. The kinetic equation considered is of the Fokker-Planck type used in the theory of Brownian motion. Linearization of the self-field reaction is made with the remainder of the constituitive terms depicting a time derivation along an electron trajectory generated by the external field, the free-space transverse electric vector. Use of the Green's function for the self-fieldless case obtains an integral equation for the true field. General time and frequency domain criteria are established defining sufficient conditions under which the self-field reaction is negligible. Application to a propagating wave of some curvature obtains a form of nonlinear mode-coupling transformation in which energy is transferred from the electromagnetic field to the electron flow field. Semiquantitative estimates are derived for the spatial attenuation coefficient and effective plasma frequency modification. (auth)

35550 PLASMAS AND THE HYPERFREQUENCY ENGINEER. Chodorow, M.; Kino, G. S. (Stanford Univ., Calif.). Onde Elec., 45: 421-8(Apr. 1965). (In French)

The substantial work carried out at Stanford University on plasmas is discussed. These offer many possibilities at hyperfrequency either as active devices or as passive devices, but some considerable difficulties do remain. However, the study of plasmas has disclosed applications in fields other than that of hyperfrequencies, such as thermo-ionic conversion, ionic meters, magnetohydrodynamics and thermonuclear fusion. (auth)

35551 PARTITION FUNCTION FOR ONE ELECTRON IN A PLASMA; SAHA EQUATION. Dekeyser, R. (Rijksuniversiteit, Utrecht). Phys. Letters, 16: 249-50(June 1, 1965).

The partition function of an electron in a hydrogen plasma was calculated by dividing it in three parts. The possible situations are: (1) The bound states that the electron can form with any of the ionized protons, but only up to a certain maximum energy $-A = -E_0/\nu^2$ corresponding to a principal quantum number ν. (2) The situations where the

electron comes closer to any of the ionized protons than a distance e^2A, but with an energy higher than the maximum -A; this imposes a minimum condition on the electron momentum. (3) The situations where the electron is farther away than e^2/A from each of the protons. (M.O.W.)

35552 MOVING STRIATIONS POSSIBLY DOMINATED BY RECOMBINATION. Woolsey, G. A.; Brown, J. M.; McCloskey, J. J. G.; Emeleus, K. G. (Queen's Univ., Belfast). Phys. Letters, 16: 252(June 1, 1965).

The existence of moving striations (self-excited ionization waves) in discharges through iodine vapor is investigated. Possibilities of the alteration of the striations in the presence of large numbers of negative ions are discussed. (M.O.W.)

35553 VELOCITY AND ATTENUATION OF LONGITUDINAL ION WAVES IN A WEAKLY IONIZED GAS PLASMA. Sessler, G. M. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Letters, 16: 277-8(June 1, 1965).

Measurements of the propagation constants of longitudinal ion waves in weakly ionized nitrogen at angular frequencies greater than the ion-neutral collision frequency are reported. The measurements show an unexpected frequency dependence of both the phase velocity and attenuation. (M.O.W.)

35554 ELECTROSTATIC INSTABILITIES IN A PLASMA WITH ANISOTROPIC VELOCITY DISTRIBUTION. Shima, Yaakov (Oak Ridge National Lab., Tenn.); Hall, Laurence S. Phys. Rev., 139: 1115-16(Aug. 16, 1965).

An anisotropic magnetized plasma, in which the distribution of particle velocities is a bi-Maxwellian characterized by the temperatures $T_\perp$ and $T_{||}$, is considered in order to delimit as much as possible the location of possibly unstable roots to the dispersion equation. It is found that marginally unstable roots of the dispersion equation can occur only if both $[l + \frac{1}{2}] < \omega < [l + 1 - (T_{||}/T_\perp)]$ and $\omega < (T_\perp - T_{||})/T_{||}$, where l is an integer and ω is the real part of the frequency in units of the cyclotron frequency. Thus, in particular, the system is stable if $T_\perp < 2T_{||}$. (auth)

35555 THE RADIATIVE TRANSFER OF IMPACT-BROADENED SPECTRAL LINES EMITTED BY AN ARGON PLASMA DESCRIBED BY THE LOCAL THERMODYNAMIC EQUILIBRIUM APPROXIMATION. Burgess, D. D.; Cooper, J. (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 85: 1261-8(June 1965).

Plasma composition calculations in the local thermodynamic equilibrium approximation are carried out for an argon plasma at high densities. These calculations are then applied to the consideration of the radiative transfer in a homogeneous plasma of spectral lines broadened alternatively by the thermal Doppler effect or the Stark effect produced by electron impacts. In particular the results are contrasted for lines emitted by ionized species and it is shown that the nature of impact broadening sets an absolute upper limit to the optical depth which can be achieved for a given path length and transition, regardless of plasma conditions. Under certain conditions this consequence of impact broadening also results in the peak height of an optically thin line emitted by an ion being of interest for determinations of the plasma temperature. (auth)

35556 ELECTRON BEAM PROBING OF PLASMAS. Harp, R. S.; Cannara, A. B.; Crawford, F. W.; Kino, G. S. (Stanford Univ., Calif.). Rev. Sci. Instr., 36: 960-8(July 1965). (SUML-1260).

Measurement of static and dynamic electric fields in plasmas presents considerable experimental difficulties, particularly in regions such as sheaths, where the fields vary rapidly in space and common techniques such as the use of probes are not applicable. An extremely powerful approach is to employ an electron beam probe. This technique is a very old one which in recent years has passed through several stages of refinement. The authors review the previous work and describe in detail a system suitable for measuring accurately d-c and r-f fields up to several hundred Mc in low pressure discharges. The apparatus has been used to make a wide variety of measurements of plasma properties, and the associated techniques that have been developed are presented. These include methods of plasma production and of precision measurement of r-f fields in amplitude and phase. (auth)

35557 ELEKTROMAGNITYNE FLUKTUATSII V PLAZME. (Electromagnetic Fluctuation in Plasma). Sitenko, A. G. Kharkov, Publishing House of Kharkov Order of the Red Banner of the State Univ., 1965. 184p.

Theoretical studies were made of electromagnetic properties of plasma. High-frequency properties of isotropic and magnetoactive plasma and propagation of electromagnetic, hydromagnetic, and plasma waves are investigated. Spectral distributions of various magnitude fluctuations in plasma and, in particular, in nonisothermal plasma were determined. Properties of quantum and superconducting plasma, scattering of electromagnetic waves on fluctuations in plasma, and reactions of charged particles with plasma are discussed in detail. 774 references. (R.V.J.)

35558 KOLLEKTIVNYE KOLEBANIYA V PLAZME. (Collective Oscillations in Plasma). Akhiezer, A. I.; Akhiezer, I. A.; Polovin, R. V.; Sitenko, A. G.; Stepanov, K. N. Moscow, Atomizdat, 1964. 163p.

The theory of linear oscillations in collisionless plasma (in which pair collisions do not effect plasma oscillations), intrinsic oscillations spectra, stability, and instability of various particle distributions, and fluctuations in homogeneous plasma are discussed. Vertical oscillation spectra for equilibrium and two-temperature plasma in the absence and presence of an external magnetic field, the frequencies and damping decrement (caused by resonance interactions between particles and the field) Langmuir oscillations, nonisothermal sound, modified Langmuir oscillations in a magnetic field, electron- and ion cyclotron waves, and magnetohydrodynamic waves are considered. Scattering and transformation of waves and scattering of charged particles in plasma are also discussed. 147 references. (R.V.J.)

35559 FOUNDATION OF PLASMA DYNAMICS. Holt, E. H.; Haskell, R. E. New York, The Macmillan Co., 1965. 525p. $12.95.

A mathematical treatment of plasma dynamics is given. Elastic collision processes, plasma kinetic theory, charged particle orbits and interactions, wave phenomena, plasma oscillations, electromagnetic waves, magnetofluiddynamics, and electronic processes are considered. (J.F.P.)

35560 CONTROLLED THERMONUCLEAR RESEARCH. p.74-82 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Developmental progress and operations of several thermonuclear plasma devices are reviewed. (T.F.H.)

35561 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUSION REACTORS. Hansen, Siegfried; Fonda-Bonardi, Giusto (to Litton Industries Inc.). British Patent 996,239. June 23, 1965. Filed Aug. 10, 1962.

A nuclear fusion reactor includes an annular-shaped particle accelerator for accelerating an annularly shaped plasma body towards its own center by means of a moving, preferably accelerating, magnetic field. The plasma mass is electrically neutral, unconfined, high-density at relatively low temperature and comprises mixed deuterium and tritium supplied to the accelerator from a gas source by way of an ionization chamber(s). The body of particles converges toward the center at high speed so that the particles have sufficient energy to fuse upon collision in the region of the center. A neutron-impeding body surrounds the collision region and forms the heater of a steam generator. A field coil in the proximity of the collision region is disposed in such a way that the charged particles generated by the collision induce an emf in the coil. After collision, means are provided for recirculating the particles from the colli-

sion region not involved in the collision and for supplying particles to take the place of those removed by collision to the accelerator. (B.L.M.)

Shielding

Refer also to abstract 34566.

35562 (AFWL-TR-65-3) PROTON ABSORPTION IN DOSE-EQUATED MATERIALS. Janni, Joseph F. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). Apr. 1965. 192p. CFSTI

Theoretically calculated values of the proton ionization interactions, including dE/dx and LET values, are presented for numerous materials and compared with the values for ICRU tissue (muscle) and bone. The results can be used to compare and evaluate possible dosimetric media for dose equivalency. Proton energies from 0.5 Mev to 1 Bev are considered. The K and L shell effects upon the stopping power equation are included. The calculation method and the resultant computer tabulations are given in detail for over seventy different materials, including common elements, plastics, compounds, gases, scintillators, thermoluminescent materials, and photoluminescent glass dosimeters. (auth)

35563 (NP-15098) SHIELDING PROBLEMS IN MANNED SPACE VEHICLES. Schofield, W. M.; Smith, E. C.; Hill, C. W. (Lockheed-Georgia Co., Marietta). Dec. 1962. Contract NAS8-879. 200p. (ER-5997)

The hazards of solar flares to manned space flights are discussed. Nuclear interactions are discussed, and a data compilation is given as an introduction to phenomena in the high-energy range. Methods of calculating radiation transport through shields, including secondaries, are discussed and the results of some sample calculations are presented. (D.L.C.)

35564 (ORNL-P-299) NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL NUCLEON-MESON CASCADE EQUATIONS. Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.); Murphy, J. E.; Barish, J. (Oak Ridge Gaseous Diffusion Plant, Tenn.). [1964]. Contract W-7405-eng-26. 14p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

In shielding calculations for high-energy accelerators it is necessary to solve the nucleon-meson cascade equations numerically for very large distances. For the case of a 10-Bev proton beam and a set of quite special physical assumptions, an analytic solution is obtained and compared with the numerical solution. The two solutions are shown to be in excellent agreement for thicknesses as large as 30 collision mean free paths (~2800 g/cm^2). (auth)

35565 (RISO-93) A LOW-TEMPERATURE TECHNIQUE FOR MEASUREMENT OF HEAVY-PARTICLE STOPPING POWERS OF METALS. Andersen, Hans Henrik (Atomenergikommissionen, Risoe (Denmark). Forsoegsinstitut). Jan. 1965. 60p. Dep.(mn).

A new method for measuring ionization stopping powers for charged particles in metals is presented. The method utilizes a thermometric compensation technique and works at liquid-helium temperature. Corrections to the measured stopping powers are discussed in considerable detail, and correction curves are given. On the basis of the discussion of corrections and errors, the total error of the data is concluded to be 0.3%. To illustrate the technique, stopping-power data for 6- to 12-Mev protons and deuterons in aluminum are presented. (auth)

35566 (RT/FI(65)-7) SUI FATTORI DI ACCUMULAZIONE: COEFFICIENTI DELLA FORMULA DI J. J. TAYLOR. (Accumulation of Build-Up Factors: Coefficients of the J. J. Taylor Equation). Buscaglione, S.; Manzini, R. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan. 1965. 11p. Dep.(mn).

Build-up factor's coefficients of J. J. Taylor equation were determined, for some of the most common materials for the construction of gamma shielding. The materials investigated are: H_2O, Al, Fe, Pb, Sn, W, U; as well as ordinary concrete, barites concrete, ferrophosphorus concrete and magnetite concrete. (auth)

35567 (FTD-MT-64-284(p.135-42)) OPTIMUM FORM OF GAMMA RADIATION SHIELD. Tokarev, V. V.; Tsvetkov, V. I. Translated from Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 1, (Jan.-Feb. 1964).

The problem of the construction of the optimum shape of protective barrier (minimum weight) was considered previously for a linear gamma source. The solution obtained was not applicable for the whole range of variation of parameters; with increase of the permissible dose at the shield position, the thickness of shielding on the edges of the sources became negative. A full solution of the problem on the optimum form of shielding is found, making the same assumptions as previously. The cases of linear, disk, and cylindrical sources are considered. (auth)

35568 (ORNL-tr-610) "MAC-RAD"—A MULTIGROUP ATTENUATION CODE FOR PLANE GEOMETRY. Preusch and Illsemann (Allgemeine Elektrizitaetsgesellschaft, Frankfurt am Main (West Germany)). Translated for Oak Ridge National Lab., Tenn., from Nuclear Energy Plants Report No. 116. Oct. 30, 1963. 91p. Dep.(mn); $8.60(fs), $2.93(mf) JCL.

"Mac-Rad" is the revised and expanded form of the Multigroup Attenuation Code MAC. A shielding program is involved which furnishes the following information in one calculation step for a plane problem as a function of the distance to the core edge: neutron fluxes; neutron dose rates; an approximated neutron spectrum; gamma fluxes; gamma dose rates; and an approximated gamma spectrum. Core and shield can be subdivided into a maximum of 20 material regions, where the first two regions are always located in the core. The number of neutron groups can amount to a maximum of 35, while the gamma fluxes are always determined for 7 groups. The radiation formed in the core is composed of the fast neutrons formed during fission and the emitted prompt gamma rays. In addition, the gamma radiation of the fission products in the steady state and the secondary gamma radiation emitted during the capture of neutrons through the core materials are taken into consideration. The neutron flux in the shield is composed of two components. The unscattered component includes all those neutrons which reach the point under consideration without interaction. It is calculated by means of the removal theory. The second component, which is determined by the diffusion theory, contains all those neutrons which already interacted with the materials in the shield. Elastic as well as inelastic scattering processes are taken into consideration. The gamma flux is calculated by means of the first-collision method. Scattering processes are taken into consideration by the build-up factor in the Taylor form. This factor is let to be equal for all materials of one shield. In the program library, the values for water, aluminum, and iron are made available. A source region in this case is not only the core but also each shield region. In the latter, the secondary gamma radiation caused by neutron capture is formulated as the source. (auth)

35569 PARABOLIC APPROXIMATION OF TOTAL ATTENUATION COEFFICIENTS OF GAMMA QUANTA AT 0.03 TO 10 Mev ENERGY RANGE. Marenkov, O. S.; Derzhimanov, R. S. At. Energ. (USSR), 18: 520-1(May 1965). (In Russian)

A possible variation of the gamma attenuation coefficient μ as a function of λ (Compton units of the wavelength) at 0.03 to 10 Mev was analyzed. The general relation of $\mu(\lambda)$ is described by the n-power polynomial $\mu(\lambda) = \rho\Sigma_{k=0}^{n} c_k\lambda^k$ (where ρ is the matter density, c_k is indefinite coefficient). The parabolic approximation for total attenuation coefficient $\mu/\rho = c_0 + c_1\lambda + c_2\lambda^2$ was calculated and the results are tabulated for: Be, C, Na, O, Mg, Al, Si, P, S, Ca, K, Fe, Cu, H_2O, sand, calcium phosphate, and concrete at 0.03 to 0.08, 0.08 to 0.3, 0.3 to 10 Mev. The maximum error of approximation did not exceed 4% at 0.03 to 0.08 Mev, 3% at 0.08 to 0.3 Mev, and 5% at 0.3 to 10 Mev. Thus, it is shown that parabolic approximations μ/ρ can be determined not only for separate elements but also for multicomponent

(concrete) and chemical compounds (water, sand, and potassium phosphates). (R.V.J.)

35570 THE INFLUENCE OF BORON-CONTAINING BLOCKING ON THE CAPTURE GAMMA RADIATION YIELD. Kozlovskii, S. A.; Koz'yurov, V. S.; Popkov, K. K.; Lebedev, D. N. At. Energ. (USSR), 18: 522-5(May 1965). (In Russian)

The influence of boron-containing blocks on the capture γ-radiation yield from the primary shielding of a water-cooled, water-moderated reactor was investigated. The reactor vessel, thermal shielding, and the water layers between the shielding were simulated by steel sheets and 800 + 800 mm plexiglass. Boron carbide slabs (filler density 1.1 g/cm^3) and borated lead consisting of red lead and boron anhydride weight ratio 1 : 9, containing ~3 wt % boron, were used as block material and 10^8 neutr/sec Po–Be source as an emitter. Curves of relative yield of capture γ radiation as a function of the blocking shielding thickness are plotted. (R.V.J.)

35571 IRON AND POLYETHYLENE ATTENUATION OF NEUTRONS PASSING THROUGH SHIELDING AT AN OBLIQUE ANGLE. Miroshnikov, G. V. At. Energ. (USSR), 18: 529-32(May 1965). (In Russian)

Neutron attenuation by thin (≤11 cm) iron and polyethylene layers was studied using photoneutron sources with neutron energies 24 kev, 0.22 and 0.83 Mev and a cascade generator capable of producing E_n = 3 Mev neutrons by D(d,n)^{3}He reaction. Experiments with 2000 × 1000 × 10 mm blocks of material placed 2 to 3 m from the source and a dosimeter and a radiometer showed that neutron dose attenuation depends on the angle of incidence and initial neutron energy. (R.V.J.)

35572 ATTENUATION OF NEUTRONS BY THIN LAYERS OF HYDROGENOUS MATERIALS. Miroshnikov, G. V. At. Energ. (USSR), 18: 532-5(May 1965). (In Russian)

Attenuation of 0.22, 0.24, 0.83, 1.0, 2.0, 3.0, and 15-Mev neutrons by H_2O d = 1 g/cm^3, polyethylene d = 0.93 g/cm^3, plexiglass d = 1.2 g/cm^3, vinyl plastic d = 1.6 g/cm^3, and vitreous plastic on expoxy resin d = 1.7 g/cm^3 was measured. An ionizing dosimeter was used for measuring maximum tissue dose of 15-Mev neutrons behind the shielding and a RUS dosimeter was used for the lower energy neutrons. The theoretical and experimental curves of the neutron dose attenuation have approximately exponential character and agree in their relative distribution. The tables of the neutron dose relaxation lengths $\alpha_d(E)$ as a function of neutron energy are given for all examined materials. (R.V.J.)

35573 STREAMING OF GAMMA RAYS THROUGH METALLIC PIPES. Kakimoto, Hiromu; Saigusa, Toshifumi; Shimizu, Sakae (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 42: 22-34(Jan. 1965).

The streaming of the 662-kev gamma rays from ^{137}Cs through steel and lead pipes of various sizes was observed using a NaI(Tl) scintillation detector. The scintillation pulse-height spectra of the diffused radiation were measured for different pipes. The measurements were performed outside with the pipes placed horizontally 2 m above the earth's surface to eliminate unfavorable scattered rays from the surroundings. To interpret the observed spectra theoretical calculations were carried out by taking account of the single scattering of radiation in the wall of the pipe. The general features of the observed phenomena could be explained qualitatively by the theoretical results. The effect of the radiation scattered twice by the wall of the pipe was also evaluated theoretically and found to be negligibly small. Experimental results and the theoretical considerations are presented. (auth)

35574 FAST REACTOR SHIELDING. Hungerford, H. E. (Purdue Univ., Lafayette, Ind.). p.244-6 of ANS-100.

Theory, design, and materials for fast-reactor shielding are outlined briefly. (T.F.H.)

35575 STUDY OF THE SPECTRAL-ANGULAR DISTRIBUTIONS OF SCATTERED GAMMA RADIATION IN PROTECTIVE BARRIERS FOR THE CASE OF A PLANE MONODIRECTIONAL SOURCE. Stolyarova, E. L.; Chukhin, S. G.; Konstantinov, I. E.; Mis'kevich, A. I. pp 15-36 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

Results are given of measurements of the spectral-angular distributions of scattered gamma radiation, obtained using a gamma spectrometer with a large crystal and the AI-100 multichannel analyzer. Gamma scattering from a plane monodirectional ^{60}Co source in Al barriers of varying thickness was studied. It was found that the angular-energy distributions have a maximum near the energy corresponding to a single scattering at minimum angle, regardless of the angle θ, the atomic number of the medium, and the barrier thickness. The exponential dependence of the scattered gamma intensity on the angle θ was confirmed for Pb and Fe barriers. The exponential dependence was also observed for low-Z materials, e.g., Al. By comparison of the experimental data with calculations, it was shown that the single scattered gamma quanta give the basic contribution to the hard part of the scattered spectrum. (M.J.T.)

35576 ANGULAR AND ENERGY DISTRIBUTIONS OF ^{60}Co GAMMA RAYS SCATTERED IN A HETEROGENEOUS Al–Pb MEDIUM. Larichev, A. V.; Klimanova, L. F. pp 37-46 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

An experimental study is described of the angular and energy distributions of gamma rays from a plane monodirectional ^{60}Co source (gamma energies of 1.17 and 1.33 Mev) after passage through flat shielding barriers composed of Pb and Al layers. The measurements were carried out using a single-crystal NaI(Tl) scintillation spectrometer for sufficiently hard collimation of the gamma beam at angles of 0, 10, 20, 40, and 60° from the normal to the boundary plane of the barrier. The general thicknesses of the barriers varied from $\mu_0 d$ = 2 to 4. Effects of changing the order of the position of the Pb and Al layers with respect to the source were also observed. The energy and angular distributions obtained agreed with the corresponding experimental distributions for pure Pb and with the energy distributions calculated by the moments method. (M.J.T.)

35577 DEPENDENCE OF THE BUILD-UP FACTORS ON THE DISTANCE OF THE PROTECTIVE BARRIER BETWEEN THE SOURCE AND DETECTOR. Osanov, D. P. pp 53-60 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

The role of the position of the shielding barrier between the source and the detector is examined. The observed differences in the build-up dose factors in the barrier is associated with the fact that the conditions of impact of the scattered gamma radiation on the detector change for a displacement of the barrier. The divergence in the build-up dose factors in a barrier of thickness $\mu_0 d$ = 1 reaches 30% for different positions of the barrier between source and detector. (M.J.T.)

35578 METHOD OF NONLINEAR GRADIENT PROGRAMMING FOR THE CALCULATION OF MINIMUM-WEIGHT SHIELDING. Kimel', L. R. pp 61-70 of Pribory i Metody Analiza Izluchenii. Vypusk III. Moscow, Gosatomizdat, 1962. (In Russian)

A useful method of calculating local shielding from gamma radiation using nonlinear gradient programming is presented and illustrated by a simple example, the calculation of the minimum-weight of Pb shielding for a 1000-C ^{60}Co source. (M.J.T.)

35579 IMPROVEMENTS IN ENERGY ABSORBING COMPOSITIONS AND STRUCTURES. (to St. Joseph Lead Co.). British Patent 988,414. Apr. 7, 1965. Priority date July 16, 1962, United States.

A material useful for the absorption or dissipation of vibrational or radiated energy including sound waves, high-energy electro-magnetic radiations such as x rays and γ rays, and radiated particles consists of 45–95% by weight of particulate lead sulfide dispersed in a solidified organic plastic matrix material. The lead sulfide is preferably in the form of a galena concentrate. The

plastic matrix may be a thermoplastic substance, an elastomeric substance, or an asphaltic composition. The composition may be laminated upon or between sheets or webs of other material for improved strength. (A.G.W.)

35580 IMPROVEMENTS IN OR RELATING TO LIQUID FILLED WINDOWS FOR USE WITH RADIOACTIVE SOURCES. Hardy, Thomas Charles; Welsher, Ronald Andrew George (to United Kingdom Atomic Energy Authority). British Patent 995,003. June 10, 1965. Filed Apr. 9, 1962.

A radiation absorbing liquid filled window for use with a biological shield includes a plastic resin lined aperture through the shield, an undercut plastic lined recess around one end of the aperture, and a pane of transparent material in a frame bonded into the aperture recess. The pane holding frame consists of a U-shaped channel member; the pane is bonded to it; and then the unit is bonded into the recess, so that the pane and frame form an integral combination with the lined aperture. (B.L.M.)

Solid State Physics

See also CHEMISTRY — Inorganic and Physical Chemistry
METALS, CERAMICS, AND OTHER MATERIALS — Properties and Structure

Refer also to abstract 35495.

35581 (BNL-9111) EFFECT OF HYDROSTATIC PRESSURE ON HYPERFINE STRUCTURE OF S-STATE WAVE FUNCTIONS IN IONIC CRYSTALS: H AND D IN CaF_2, F CENTERS IN LiF. Blum, Haywood (Brookhaven National Lab., Upton, N. Y. and Massachusetts Inst. of Tech., Cambridge). [1964]. Contract AT-30-2-GEN-16. 19p. (CONF-650423-2). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From International Conference on Physics of Solids and High Pressures.

Electron spin resonance studies at room temperature are performed on H and D interstitial atoms in CaF_2 and on F centers in LiF at hydrostatic pressures up to 10 kbar. The hyperfine interactions of the H and D are well resolved. The results are discussed in terms of the available simple ionic models. (auth)

35582 (IFA-FN-26) CORRECTION OF INTENSITIES OF DIFFRACTION MAXIMA FOR ABSORPTION IN CYLINDRICAL SAMPLES. Bally, D.; Gheorghiu, Z.; Pasculescu, D. (Institutul de Fizica Atomica, Academia R. P. R., Bucharest). Nov. 1964. 12p. Dep.(mn).

An analytical method is given for computing the correction factor of the diffraction maxima intensity for absorption in cylindrical samples. The values of the transmission factor were calculated for the cases of a polycrystalline sample introduced into a cylindrical container and of a polycrystalline sample with annular cross section. (auth)

35583 (NYO-2391-12) AN APPROXIMATE TECHNIQUE FOR CALCULATING LOCALIZED MODES. Matthew, J. A. D. (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). June 1965. Contract AT(30-1)-2391. 30p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Asymptotic solutions for the frequency of the localized mode of an isotopic defect in a cubic lattice are examined, and interpreted in terms of the Einstein oscillator frequency of the impurity atom. The extension of such approximate solutions to situations in which the force constants change is examined and the method is applied to the case of the U center in the alkali halides. For all the alkali halide systems considered the assumption that the hydride ion behaves as an isotopic impurity gives poor agreement with experiment. It appears that the hydride ion is more softly coupled to its environment than the anion it replaces and the degree of softening increases as the size of the anion increases. (auth)

35584 (TID-21060) THERMAL CONDUCTIVITY OF INSULATING CRYSTALS IN THE PRESENCE OF NORMAL PROCESSES. Krumhansl, J. A. (Oxford Univ. (England)). [1963]. Contract AT(30-1)-1725. 20p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

The problem of computing the phonon distribution and thermal conductivity in the presence of N-processes is examined in the framework of the Boltzmann-Peierls' equation. A heat flow may be associated with drift and diffusive distributions respectively; this intuitive concept is given specific basis as a proper manner in which to solve the Boltzmann equation. The general operator form of this equation is used and the solution is expressed as the sum of the eigenstate of the N-process collision operator having zero eigenvalue and a second term; the former is the drift term and the latter is the diffusive term. The amount of the drift contribution is determined by a condition that makes the drift term orthogonal to the diffusive term. In practice, this general method may be approximated by relaxation time representation of the collision operators. The Callaway equation follows directly. The present criterion for determining the drift term differs from that of Callaway. (auth)

35585 (TID-21972) STUDIES OF PHOTOEFFECTS OCCURRING WITH ANODIZED NIOBIUM ELECTRODES (thesis). Schell, Robert Aloysius (Temple Univ., Philadelphia, Pa.). June 1964. Contract AT(30-1)-2775. 121p. Dep.(mn); $4.00(cy), 2(mn) CFSTI

Open-circuit photopotentials and short-circuit photocurrents were observed with anodized niobium electrodes. The open-circuit photovoltaic effect was generally well described by the theory of van Geel, et al., and Salomon. The relaxation phenomena was interpreted in terms of a non-equilibrium effect by which the photoexcited electrons take a rather long time to reach thermal equilibrium with the oxide lattice. The short-circuit photocurrents exhibited a maximum when viewed as a function of the oxide film thickness. This was explained on the basis of optical anisotropy in the oxide film. The spectral response curves of the short-circuit photocurrent were very unusual. The fact that there was not correspondence between these curves and the absorption spectra was rather surprising. An explanation was given in terms of interband transitions. The peaks in the curves are to correspond to optical excitations of electrons to band regions where the mobility is high. The valleys would correspond to excitations to band regions of lower mobility. A trapping scheme is postulated to explain the current-light curve characteristics. This is based on an exponential distribution of traps. The superlinearity is interpreted in terms of a redistribution of these trapping states upon illumination. In addition to the short-circuit photocurrents, normal photocurrents were also observed. The shape of the spectral response curves are similar to those of the short-circuit photocurrent for the range of applied fields investigated. (auth)

35586 (UCRL-11984) MAGNETIC PROPERTIES OF CURIUM METAL AND ITS COMPOUNDS (thesis). Marei, Sayed A. (Lawrence Radiation Lab., Univ. of California, Berkeley). May 18, 1965. Contract W-7405-eng-48. 102p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

The magnetic susceptibility of curium metal was measured from −253 to 250°C. The metal followed Curie-Weiss law above liquid nitrogen temperature up to the temperature studied. The effective magnetic moment for the metal was found to be 7.99 ± 0.15 indicating the presence of $5f^7$ configuration in the metal. No magnetic transition was observed in the temperature range studied. The magnetic susceptibility of Cm^{+3} in curium trifluoride, curium oxychloride, and 5.6 mole percent curium trifluoride diluted with lanthanum trifluoride was measured. The effective moment for Cm^{+3} was found to be 7.65 ± 0.1 Bohr magneton, giving a Landé g factor of 1.93 ± 0.03, pointing toward an appreciable departure from Russell Saunders coupling. The molecular field constant Δ was found to be small and decreasing with increasing magnetic dilution. The following Δ values were found for curium

compounds: CmOCl, 23 ± 3; $CmF_3 \cdot \frac{1}{2} H_2O$, 5 ± 3; and 5.6% CmF_3, 5 ± 3. (auth)

35587 (ANL-Trans-206) THE IR-SPECTRUM OF THE U-CENTER. Schaefer, G. Translated by Elmar K. Wilip (Argonne National Lab., Ill.) from Phys. Chem. Solids, 12: 233-44(1960). 19p. Dep.(mn); $1.60(fs), $0.80(mf) JCL.

The infra-red vibration absorption of a point imperfection in alkali halides, the U-center, was measured. The frequency ν corresponding to the absorption maximum depends upon the lattice spacing and, in a first approximation, is given by the equation $h\nu d^2$ = const. For the examined crystals, the wavelength of the absorption maximum lies in the range between 17.75μ (NaCl) and 27.65μ (RbI). The absorption lines show a marked narrowing if the crystal is cooled from room temperature to 57°K. The half width decreases to about one tenth and is then of the order of magnitude 10^{-3} ev. For KCl and KBr at low temperatures, an oscillator strength of about 0.5 could be determined. (auth)

35588 INVESTIGATION OF PHONON SPECTRA IN COPPER LATTICE BY MEANS OF INELASTIC NEUTRON SCATTERING. Vintaikin, E. Z.; Gorbachev, V. V.; Gruzin, P. L. At. Energ. (USSR), 18: 507(May 1965). (In Russian)

Descriptions are given of the method and equipment for determining phonon frequencies in copper monocrystals, in the symmetry directions (100), (110), and (111), by means of inelastic neutron scattering. (R.V.J.)

35589 THE LIFETIME INTERVENING IN THE MEASUREMENTS OF THE GENERATION-RECOMBINATION BACKGROUND IN SEMICONDUCTORS. Gouskov, Leone; Nougier, Jean-Pierre; Savelli, Michel (Faculte des Sciences, Montpellier, France). Compt. Rend., 260: 4473-6(Apr. 26, 1965. (In French)

The time constants (mean life of the carriers in the conduction band and the valence band) intervening in the generation-recombination background spectra that appear in semiconductors are defined. The capture cross sections of electrons by donors and of holes by acceptors were measured at room temperature. (tr-auth)

35590 EXCITATION OF EXCITONS BY FAST ELECTRONS IN ALKALI HALIDES. Sueoka, Osamu (Tokyo Univ.). J. Phys. Soc. Japan, 20: 877(May 1965).

The energy loss spectra of fast electrons in alkali halide crystals was investigated. The energy of loss peaks in alkali-halide spectra was found to agree with the energy of excitation of excitons. An energy analyzer attached to an electron microscope was used with an accelerating voltage of 45 kev. Specimens were made by evaporation. The energy intensity curve is shown. (J.F.P.)

35591 SOME OBSERVATIONS RELATED TO ELECTRON-PHONON N-PROCESSES IN ANTIMONY AT LIQUID ^{4}He TEMPERATURES. Long, J. R.; Grenier, C. G.; Reynolds, J. M. (Louisiana State Univ., Baton Rouge). Phys. Letters, 16: 214-15(June 1, 1965).

Several special features associated with conduction of heat by the lattice were found in the transport coefficients of antimony at liquid ^{4}He temperatures. These observations resulted from a study of six experimental coefficients measured in the basal plane of an antimony single crystal with magnetic fields along the trigonal axis varying from zero to 18 kg. Two sets of findings reported are consequences of the fact that both thermal and electrical processes in the crystal, including those of the lattice, were dominated by electron-phonon N-scattering. (M.O.W.)

35592 THE RANGE OF THE CRITICAL FLUCTUATIONS OF THE SUBLATTICE MAGNETIZATION IN Cr_2O_3 AND ALPHA-Fe_2O_3 AND ITS TEMPERATURE VARIATION. Riste, T. (Institutt for Atomenergi, Kjeller, Norway); Wanic, A. Phys. Letters, 16: 231-2(June 1, 1965).

Experimental values of the range of the critical fluctuations of the sublattice magnetization in Cr_2O_3 and in α-Fe_2O_3 were previously reported. This range is the inverse of κ_1 that appears in exp $(-\kappa_1 r)$, the exponential part of the spin correlation function. The observed temperature variation of κ_1 is investigated and found to be in direct agreement with previous theoretical predictions. (M.O.W.)

35593 PULSED DE HAAS-VAN ALPHEN EFFECT IN ANTIMONY. Yamaguchi, Y.; Tanuma, S. (Tokyo Univ.). Phys. Letters, 16: 237-8(June 1, 1965).

Measurements of the de Haas-van Alphen effect in antimony at 1.7°K in magnetic fields up to 82 kOe by a pulsed technique are reported. The specimen was spark cut from zone refined single crystal of 99.9999% purity. Different angles of the magnetic field and specimen were considered. (M.O.W.)

35594 OPTICAL PROPERTIES OF DIVALENT RARE-EARTH METALS AND ALKALINE-EARTH METALS. Mueller, W. E. (IBM Research Lab., Zurich). Phys. Letters, 17: 82-3(July 1, 1965).

The absolute reflectances of strontium, barium, europium, and ytterbium were measured to give insight into the band structure of a metal. In an ultra-high vacuum, films of these metals were evaporated on sapphire substrates and reflectance measured through a sapphire window. While specific interband transition cannot yet be assigned to observe absorption peaks, the results show that no 4f electrons of rare earths are involved. (J.F.P.)

35595 PROPER FUNCTIONS FOR A BLOCH ELECTRON IN A MAGNETIC FIELD. Zak, J. (Israel Inst. of Tech., Haifa). Phys. Rev., 139: 1159-62(Aug. 16, 1965).

Functions are defined as products of a properly symmetrized function for a free electron in a magnetic field and of a Bloch-type function. An equation is derived for the Bloch-type function, and it is shown that in general the energy for a Bloch electron in a magnetic field is obtained by superimposing Landau levels on the energy spectrum of the crystal. The treatment is based on the symmetry of the equation for a Bloch electron in magnetic field. (auth)

35596 FERMI SURFACES OF Cr, Mo, AND W BY THE AUGMENTED-PLANE-WAVE METHOD. Loucks, T. L. (Iowa State Univ., Ames). Phys. Rev., 139: 1181-8(Aug. 16, 1965). (IS-1101)

The Fermi surfaces of chromium, molybdenum, and tungsten were calculated using linear-variation functions consisting of 19 augmented plane waves (APW). The muffin-tin potential was constructed from a superposition of atomic potentials centered on the lattice sites. The atomic orbitals were solutions of the Hartree-Fock-Slater self-consistent field. Constant-energy surfaces throughout the Brillouin zone and the volume contained by each of the regions were determined. The Fermi surface was selected from these energy surfaces by the requirement of equal hole and electron volumes. The density of states at the Fermi energy was determined from the slope of the volume-vs-energy curve. The Fermi surfaces of Mo and W were found to be almost identical and similar to the model postulated by Lomer for the Cr-group metals. The Fermi surface of Cr, however, differs from the other two by the disappearance of the hole pockets around N and a shrinking of the knobs on the electron jack. A quantitative comparison between experimental results and the Fermi surface of Mo is presented. (auth)

35597 RELATIVISTIC ELECTRONIC STRUCTURE IN CRYSTALS. I. THEORY. Loucks, T. L. (Iowa State Univ., Ames). Phys. Rev., 139: 1333-7(Aug. 16, 1965). (IS-1103)

A relativistic generalization of the augmented-plane-wave (APW) method is presented. The upper components of a Dirac plane wave are joined continuously on the Slater sphere to a linear expansion of central-field Dirac orbitals. The lower components of the functions in the two regions are discontinuous. A variational expression for the energy which is appropriate for this type of basis function is developed. The matrix elements between these relativistic APW's are derived and compared with the nonrelativistic case. (auth)

35598 REPRESENTATION OF GREEN'S FUNCTIONS BY PATH INTEGRALS. Rittenberg, V.; Banyai, L. (Roumanian Academy, Bucharest). Phys. Status Solidi, 10: No. 1, K17-20(July 1, 1965).

The time-dependent one-electron Green function and the Matsuba Green's function for electrons interacting with phonons in insulators are expressed by path integrals using field theoretical methods. (J.F.P.)

35599 USE OF MULTI-QUANTUM TRANSITIONS IN MEASURING SPIN-LATTICE RELAXATION TIME. Klyshko, D. N. (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 3, 152-3(May-June 1965). (In Russian)

A significant error in the measurement of the spin-lattice relaxation time T_1 by the saturation method arises in the calibration of the amplitude of the saturating field H_1 in the sample. Another insufficiency of this method is the fast decrease of the signal/noise ratio for increasing H_1 due to the simultaneous decrease of signal amplitude and increase of spectroscope noise. Methods are presented for calibrating H_1 and for indicating the saturation effect, not giving a decrease of the signal/noise ratio during saturation of the sample. In these methods, many-quantum transitions in the two-level system are used. (tr-auth)

35600 VARIATION OF THE PERIOD OF THE MAGNETIC ORDERING IN THE HEAVY RARE EARTH METALS. Miwa, H. (Oxford Univ.). Proc. Phys. Soc. (London), 85: 1197-1207(June 1965).

The variation of the period of the magnetic orderings in the heavy rare earth metals with temperature and over the series of metals and alloys is calculated with the free-electron model and a δ-function type exchange interaction between the conduction electrons and the localized spins. The total energy and then the period are calculated numerically as functions of two parameters which characterize the long-range order and the spin-disorder scattering. The results of the calculation agree qualitatively with the experimental variation. However, the exchange interaction constant, the only adjustable parameter in the theory, cannot be uniquely determined. (auth)

35601 ATOMIC AND IONIC IMPACT PHENOMENA ON METAL SURFACES. Kaminsky, Manfred. New York, Academic Press Inc., 1965. 413p. $14.50.

Atomic and ionic impact on metal surfaces are discussed. The collisions of neutral or charged gaseous particles with solid surfaces govern many physical and chemical phenomena. The gas/solid phenomena are shown to depend on a great variety of processes such as the charge transfer of the gas/solid intersurface, adsorption and desorption, and the energy transfer between an incident particle and the surface. Topics covered include: the nature of the metal surface; determination of the work function of metal surfaces; preparation of metal surfaces; binding forces effective in the collision of atoms and molecules with metal surfaces; energetics of surface reactions; inelastic collisions of atoms and molecules with metal surfaces; the accommodation coefficient; elastic collisions of atoms and molecules with metal surfaces; emission of positive ions formed at metal surfaces (surface ionization); formation and emission of negative ions at metal surfaces (NSI); sputtering of metal surfaces by ion bombardment; ion scattering from metal surfaces; neutralization of ions on metal surfaces (potential emission of secondary electrons); de-excitation of metastable atoms and ions on metal surfaces; the emission of electrons from metal surfaces by bombardment with charged and uncharged particles (kinetic emission). (F.J.H.)

35602 ENERGY BAND THEORY. Callaway, Joseph. Pure and Applied Physics. A Series of Monographs and Textbooks. Volume 16. New York, Academic Press, 1964. 365p.

The principles and methods of the calculation of electron energy levels in crystals are surveyed, together with the results of some experimental and theoretical determinations of the band structures of some materials. The effects of external perturbations, including electric and magnetic fields, on band structures are considered, together with the energy levels of electrons bound to point impurities. 500 references. (D.C.W.)

REACTOR TECHNOLOGY

General

Refer also to abstract 35378.

35603 (ANL-7045) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, APRIL 1965. (Argonne National Lab., Ill.). May 19, 1965. Contract W-31-109-eng-38. 77p. Dep.; $3.00(cy), 2(mn) CFSTI.

Summaries of research and development are presented in sections on liquid metal cooled reactors, general reactor technology, advanced systems, and nuclear safety. Separate abstracts were prepared for each section. (J.R.D.)

For abstracts of individual sections see: 35604, 35605, 35606, and 35607.

35604 (ANL-7045(p.1-23)) LIQUID-METAL COOLED REACTORS. (Argonne National Lab., Ill.).

Operation and maintenance of EBR-II are described, and design and development of FARET control drives, instrumentation, and static vessels are discussed. Investigations of Na-air reactions are described. FARET reactivity using carbide-fueled cores was investigated. Doppler experiments with ZPR-3 Assembly 45 are reported. Assembly #6 was reloaded in the ZPR-9 facility. Data on critical properties of assembly 6 are included. Design work on ZPPR is summarized. Development of refractory alloys for use in O_2-contaminated Na is discussed along with progress in fast reactor fuel processing. (J.R.D.)

35605 (ANL-7045(p.24-48)) GENERAL REACTOR TECHNOLOGY. (Argonne National Lab., Ill.).

Information is presented on ^{238}U capture rate, inelastic scattering from Cr, Fe, and Ni, and diffusion theory calculations. Data and information are included on mechanical properties of UO_2, thermal stability of uranium ceramics, and corrosion of Mo and Ti by Li at high temperatures. Developments in ultrasonic testing of fuels and reactor materials are reported along with development of ultrasonic transducers and neutron-image intensifiers. Tests of thermal conductivity of irradiated metal fuels are reported. Investigations are reported on Na two-phase flow, boiling liquid metal technology, thermal radiation heaters, and heat transfer in liquid metal flow. Development of fluidization and volatility processes is reported, and purification of Na is described. Operation and maintenance of the EBWR facility is described. (J.R.D.)

35606 (ANL-7045(p.49-59)) ADVANCED SYSTEMS RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

Critical experiments in the AARR are described. Heating rates in the AARR reactor thermal column for Al, Be, and water were measured along with heat transfer through fuel plates. Investigation pressure vessel stresses is described. Research on magnetohydrodynamic cells and regenerative emf cells is reported. (J.R.D.)

35607 (ANL-7045(p.60-9)) NUCLEAR SAFETY. (Argonne National Lab., Ill.).

Research is reported on fast reactor safety, TREAT operations and metal–water reactions. (J.R.D.)

35608 (APDA-170) QUARTERLY TECHNICAL PROGRESS REPORT ON AEC-SPONSORED ACTIVITIES, JANUARY–MARCH 1965. (Atomic Power Development Associates, Inc., Detroit, Mich.). Contract AT(11-1)-865. 71p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Construction of the high-temperature Na–U paste loop was completed and shakedown operation was begun. Simulant studies were conducted with paste materials to determine the effect of particle size on the required lifting velocity in the slurry lines and to check the procedure for charging particles into the high-temperature loop. Tests were conducted to establish the characteristics of educators as a means of controlling paste flow rate. A program was established to study the effect of small water leaks into Na on reactor tubes. Erection of the test stand and major components of the reaction system is essentially completed. Work was begun toward establishing the response accuracy and precision of three Rhometers to Na impurities at 450 to 900°F. Sodium carbonate and water were introduced into the loop Na as impurities. Experimental results indicate that sodium carbonate did not dissolve in the Na and that its solubility in Na might be lower than previously reported. Water was injected into the loop Na and changes were recorded in Rhometer readings, plugging temperature, and cover gas constituents. New methods of Na and gas sampling were devised. The performance of the Rhometers was critically observed. Pretesting details for fuel element flow stability studies including apparatus design and procurement, were completed. An unwrapped seven-tube array, consisting of 1-inch-OD tubes with 0.050-inch spacing was tested. A data reduction computer code was outlined, and the initial segment dealing with static pressure distribution was completed and used to handle the data obtained from the unwrapped tube array. The test tank and ultrasonic pulse system, designed to measure attenuation in liquid Na are described. A small test tank was used to check the sensitivity of the electronics. Water and Hg were used as the test media and gave sufficiently strong receiving signals, which decreased exponentially with distance. (J.R.D.)

35609 (BNWL-84) CRUNCH — A GROUP-COLLAPSING CODE FOR FAST REACTOR ANALYSIS. Little, W. W., Jr.; Hardie, R. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 29, 1965. Contract AT(45-1)-1830. 52p. Dep.(mn); $3.00(cy), 1(mn) CFSTI.

A group collapsing code for condensing fast reactor cross section data is described. The code uses the fundamental mode spectrum as a weighting function in computing few-group cross sections. The input cross sections can have up to 26 energy groups with 10 downscattering elements. The collapsed set can contain any number of groups ($1 \leq n \leq$ number in input set). A FORTRAN IV source deck listing, input information, and a sample case are given. (auth)

35610 (EUR-2403.e) REACTOR TEMPERATURE TRANSIENTS WITH SPATIAL VARIABLES. PART I. RADIAL ANALYSIS. Caldarola, L.; Schlechtendahl, E. G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). 1965. 55p. Dep.(mn).

The equation, which describes the heat balance equation in a cylindrical fuel element under unstationary conditions, was solved by using the method of the Laplace transformation. A parametric study of the solution was developed, and it was found that the temperature transients are dependent on two parameters: the radial time scale t_r = fuel density × fuel specific heat capacity/fuel thermal conductivity (fuel radius)^2 and the dimensionless parameter γ = fuel thermal conductivity/2 × heat transfer coefficient × fuel radius. The transfer functions were antitransformed by using two different methods of approximation: one expressed in sums of exponentials and the other with the error function. Numerical examples are included with reference to SEFOR reactor and to power reactors. (auth)

35611 (HW-84384) RESEARCH AND DEVELOPMENT PROGRAMS EXECUTED FOR THE DIVISION OF REACTOR DEVELOPMENT. QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1964. Green, J. K., ed. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Dec. 1964. Contract AT(45-1)-1350. 90p. Dep.; $4.00(cy), 2(mn) CFSTI.

Information is presented in sections on analytical studies and advanced concepts, chemical research and development, fuel studies, gas-cooled reactor studies, instrumentation and nondestructive testing, x radiation effects on

materials, physics, and Plutonium Recycle Test Reactor operation. Separate abstracts were prepared for each section. (J.R.D.)

For abstracts of individual sections see: 34302, 34425, 34628, 34744, 34745, 35612, 35759, and 35832.

35612 (HW-84384(p.3.1-11)) ANALYTICAL STUDIES AND ADVANCED CONCEPTS. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Research summaries are presented on cost factors of ^{239}Pu production, and estimation of resonance interference effects on capture-to-fission ratios of ^{239}Pu. Development of MELEAGER and JASON-SUPERCASE-MELEAGER codes is reported along with codes for fuel cycle analysis chain and cross-section data for MELEAGER. Advanced reactor studies are described for Segmented Fast Reactor, fast reactor core heat transfer, integrated fast reactor fuel cycles, nuclear safety of PuO_2-UO_2 fuels, Phoenix fuels, and fueling fast compact reactors using Pu and ^{233}U. (J.R.D.)

35613 (LA-3316) QUARTERLY STATUS REPORT ON ADVANCED REACTOR TECHNOLOGY (ART) FOR PERIOD ENDING APRIL 30, 1965. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). May 1965. Contract W-7405-eng-36. 49p. Dep.; $3.00(cy), 1(mn) CFSTI.

Results of a LAMPRE transfer function review is presented along with a discussion of fuel testing in Omega West Reactor Experiment. Component design and development for the Fast Reactor Core Test Facility is summarized. Supporting research and development are reported on activation determination of O_2, reactor blanket systems, Pu alloys and cermets, Los Alamos Turret Reactor, Plasma thermocouples, and heat pipes. (J.R.D.)

35614 (NAA-SR-8884) CURIE-DOSE-THUNDERHEAD—A DIGITAL COMPUTER PROGRAM FOR EXTERNAL AND INTERNAL RADIATION DOSE CALCULATIONS. Kenfield, G. P.; Lahs, W. R.; Sayer, W. B.; MacAdams, R. M.; Harris, N. A. (Atomics International, Canoga Park, Calif.). June 15, 1965. Contract AT(11-1)-Gen-8. 39p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The CURIE-DOSE-THUNDERHEAD program is a combination of three basic computer programs employed in succession. The first, CURIE, calculates the ^{235}U fission-product buildup and decay as a function of reactor operating time, operating power, and decay time. The second, DOSE, uses the fission product inventory obtained from CURIE to calculate the dose to 14 internal body organs due to inhalation of fission products released to the atmosphere. The third, THUNDERHEAD, uses fission product activity data from CURIE to calculate the external cloud gamma exposure from the released fission products. (auth)

35615 (NP-15037) REACTOR RESEARCH REPORT. (McMaster Univ., Hamilton (Ontario)). Jan. 1965. 75p. Dep.(mn).

Descriptions of the McMaster reactor and facilities are presented along with summaries of research. Research is described on Fe sorption during $LiCl_2$ cleavage dissolution, alpha activity, gamma angular correlations, atomic beams, nitrofuran derivatives effects on micro-organisms, oxidation of Zr, densitometers for peat, neutron activation determination of S, radiation effects on chloroplasts, radio-induced polymerization of styrene with wood cellulose, geochemistry of Pt metals, mass spectrometry of fission and decay, transfer of P between slag and Fe, fission yields of ^{241}Pu, ^{229}Th, and ^{238}U, lattice dynamics of Sn, neutron diffraction of H atoms in colemanite crystals, nuclear pulse spectrometry, radiation biology, radioinduced halogenation of CH_4, fission yields of Th, preparation of ^{64}Cu, beta and gamma spectroscopy, and tracer studies of plant biosynthesis. (J.R.D.)

35616 (ORNL-RSIC-8) SURVEY OF METHODS FOR CALCULATING GAMMA-RAY HEATING. Claiborne, H. C. (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 119p. Free(ORNL).

The engineering design of nuclear reactors is largely governed by the heat liberated in the fission process and the subsequent absorption of the associated radiation. External to the fuel region, the main contribution to the heat generation rate usually results from energy degradation and absorption of gamma photons escaping from the fuel region. For some design conditions, gamma radiation arising from neutron capture can contribute significantly to the heat generation rate. Only heat generation due to gamma rays, regardless of the source, interacting with the usual reactor materials is considered. Various methods used in calculating gamma-ray heating for reactor design purposes are examined. Comparisons of experiments with calculations are made where possible and recommendations are made as to the applicability of each method to reactor design. The methods discussed that are adaptable to hand calculations include the buildup factor method and the straightahead-scattering method. Other methods require a high-speed digital computer. These include the differential energy spectrum method and the same methods used in neutron attenuation, namely, Monte Carlo, direct integration of the Boltzmann equation, moments method, S_n and P_n approximations to the Boltzmann equation, and diffusion theory. A listing of the available machine codes is made for each method. (auth)

35617 RESEARCH CENTRES IN EUROPE—NO. 5. CERN. EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH. Euro Nucl., 2: 237-48(May 1965).

The activities, facilities, and organization of CERN are briefly discussed, including the 600-Mev synchrocyclotron, the 28-Mev proton synchrotron, bubble chamber studies of interactions, data acquisition and reduction techniques, fragmentation studies, storage ring development, computer usage, supporting activities, and future plans. (D.C.W.)

35618 PRESENT STATE OF SEMIHOMOGENEOUS REACTORS. Nishivoli, I. Genshiryoku Kogyo, 9: No. 10, 33-7(1963). (In Japanese)

The status of semihomogeneous reactors is discussed with specific consideration of suitable fuels and moderators. The merits of dispersion fuels, particularly UC prepared by dispersing UO_2 in graphite, are considered; and two types of semihomogeneous fuel (confined and free) are described, together with methods for preparing them. In addition, two types of impermeable graphite for use in coating semihomogeneous fuels are described, including their properties and preparation. The method for obtaining high heat transfer in semihomogeneous reactors is given in detail. It is also noted that for temperatures near 1000°C, helium and bismuth are the only suitable gas and liquid metal for use in cooling semihomogeneous reactors. The advantages of bismuth for this application are discussed. (D.C.W.)

35619 ANALYZING THE EFFECTS OF A ZIRCONIUM-WATER REACTION. Baker, Louis Jr.; Ivins, Richard O. (Argonne National Lab., Ill.). Nucleonics, 23: No. 7, 70-4 (July 1965).

The effects of a zirconium-water reaction are analyzed with an emphasis on safety. The design and development discussion includes chemical reaction energy, steam supply, core reaction and integrity, and the reaction after collapse of the core. Several families of curves are included. (J.F.P.)

35620 FLUID AND THERMAL TECHNOLOGY. Power Reactor Technol., 8: No. 2, 118-25(Spring 1965).

Thermal conduction studies in fuels and fuel elements are discussed, including results of measurements and surveys of computer codes for calculating temperature distributions. Studies on thermodynamic and heat-transfer properties of gases are reviewed. Measurements of heat flux, transients, and mixing in pressurized water are discussed. Work on heat transfer in organic coolants is cited. 22 references. (M.J.T.)

35621 COMPONENTS. Power Reactor Technol., 8: No. 2, 133-6(Spring 1965).

A description of the design and the results of testing of the EBR-II control-drive mechanisms are given. Problems in the selection, fabrication, installation, and testing of the NPR primary-loop process tubes and fittings are described. (M.J.T.)

35622 FUELS AND MATERIALS. p.99-111 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

The development of fuels and fertile materials, structural and cladding materials, and moderator, reflector, and coolant materials for nuclear reactors is reviewed. (T.F.H.)

35623 REACTOR INSTRUMENTATION AND HEAT TRANSFER RESEARCH. p.120-9 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

The development of reactivity meters, high-temperature sensors, miniature neutron detectors, strain gages, and steam-water level detectors for reactors is reviewed. Heat transfer analyses for water, gas, and liquid-metal cooled reactors are outlined. (T.F.H.)

35624 NUCLEAR SAFETY RESEARCH. p.155-65 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Reactor safety studies concentrating on reactor kinetics, fuels, and containment are reported. Associated studies on pipe ruptures and fuel shipping containers are discussed. (T.F.H.)

35625 IMPROVEMENTS RELATING TO CONTAINERS FOR NUCLEAR FUEL ELEMENTS. Connor, Frederick Percy; Craddock, Ivan Thomas (to John Thompson Ordnance Co., Ltd.). British Patent 995,067. June 10, 1965. Filed Nov. 26, 1963.

A dispensable bottle for spent or defective fuel elements includes a body of sheet metal of generally tubular form closed at one end. An integral seating is formed adjacent to the open end. A closure member is adapted to fit internally into the body at the open end. The closure member includes a portion opposed to the seating on the body to exert pressure on a deformable sealing ring placed between the seating and the opposing portion. The closure member has an outwardly axially extending flange at its periphery over which the marginal portion of the body is deformed inwardly either continuously or at intervals to engage the flange of the closure member and maintain it in pressure contact with the sealing ring. The apparatus is also provided that includes a peripheral die adapted to externally engage the portion of the body that provides a seating for the closure member and support the body of the bottle. Housing guiding walls extend upwardly and axially of the die and guide a punch in slidable movement towards and away from the die to deform the rim of the body over the closure member. The die and punch form walls of a chamber that is closed except for a passage to permit the inert gas to be passed into the chamber so that the bottle may be filled prior to sealing. (B.L.M.)

Auxiliaries and Components

35626 (SROO-207-30) HYDRAULIC BALL (HY-BALL) CONTROL SYSTEM DEVELOPMENT PROGRAM. Final Report. Weems, S. J.; Turner, S. E.; Lyerly, R. L.; Blair, D. J.; O'Brien, W. S. (General Nuclear Engineering Corp., Dunedin, Fla.). June 5, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(38-1)-207. 340p. (EURAEC-1266). Dep.; $4.00(cy), 6(mn) CFSTI

Physics analyses were conducted to define operational requirements of the Hy-Ball control system and to provide means for evaluating the potential gains in core performance which might accrue to the system. Calculations were made to show the effects on the radial and local power distributions due to a number of different Hy-Ball insertion configurations. Reactor parameter studies were conducted to indicate the optimum diameter of the control elements to be used in a Hy-Ball column for a 300-Mw(e) boiling water reactor. This reactor design was based on fuel consisting of rods of UO_2 pellets clad with Zircaloy-2. The largest diameter control element considered was 1.375 in.; the smallest was 0.5 in. The length of a control element column was determined by the core height to be about 10 ft. Studies showed that a plurality of Hy-Ball columns could be activated simultaneously by a single control valve system without excessive changes in reactivity. The major design and test efforts were based on the use of a pilot-operated three-way valve for use as the main system control valve. Two buffer systems for stopping the Hy-Ball column control elements (in the in-core position) were tested: a labyrinth-piston buffer and a flow-control-type buffer. A reference design Hy-Ball control system for a 300-Mw(e) boiling-water reactor was prepared to define realistic system parameters and to provide an indication of the potential cost savings due to the use of this system. The reference design was also evaluated with regard to safety hazards. (M.C.G.)

35627 (WCAP-3269-38) THE ANALYTIC REPRESENTATION OF ROD CLUSTER CONTROL ELEMENTS IN NUCLEAR DESIGN CALCULATIONS. Eich, W. J.; Williams, H. T. Jr.; Aisu, H. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Oct. 1964. Contract AT(30-1)-3269. 141p. Dep.(mn); $4.00(cy), 3(mn) CFSTI.

Analytic schemes for the representation of Rod Cluster Control elements in reactor core design calculations were developed and compared with experiment. Theoretical bases and limitations of these methods are discussed. Finally, procedures are provided to expedite the application of these methods to design. In the course of this comparison between analysis and experiment, a fundamental improvement was made in the analytic form used in the "worth" comparison. This improvement has relevance to all analysis compared with results derived from any form of "worth" substitution experiments. (auth)

35628 TECHNOLOGY FOR DEVELOPING FILTERS FOR PURIFICATION OF ORGANIC COOLANT AND INVESTIGATION OF THEIR HYDRAULIC RESISTANCE. Tokarev, Yu. I.; Bogdanov, F. F.; Pavlovskaya, E. I.; Chernopyatova, A. P. At. Energ. (USSR), 18: 478-83 (May 1965). (In Russian)

Experiments were made with hydraulic resistance of metal-ceramic disc filters for filtering organic coolants at working conditions. Preparation of filters and their use under operating conditions are described. The function $\zeta = f(Re)$ in capillaries of the filter is described by empiric relation $\zeta = C/Re^n$. It is shown that the prepared filters can be reclaimed by a reverse flow of coolant (5 to 8 l). (tr-auth)

35629 PROPOSED STANDARD. PROPOSED STANDARD FOR CLEANING NUCLEAR REACTOR SYSTEM COMPONENTS. Savolainen, Ann W., ed. Nucl. Eng. Bull., 3: 1-7(May 1965).

The standard defines classes of cleanliness and provides methods for specifying degrees of cleanliness for components to be installed in nuclear systems. Examples from industrial experience are cited as guides. (J.F.P.)

35630 HYDRODYNAMIC REACTOR-FUEL TRANSFER. Erkes, P. (Bureau d'Etudes Nucleaires, Brussels). Nucleonics, 23: No. 7, 82-3(July 1965).

A simple fuel-transfer-tube system is developed in which the transfer is accomplished hydrodynamically through a tube between the reactor pool and the spent-fuel storage pool. Its design, operation, and economics are discussed. Diagrams are included. (J.F.P.)

35631 ADVANCED STEAM CONDITIONS ARE JUSTIFIED FOR NUCLEAR POWER PLANTS. PART II. Fiehn, A. J.; Schoenwetter, Henry D. (Burns and Roe Inc., New York). Power Eng., 69: 59-60(Mar. 1965).

Some differences in equipment cost, fuel cost and capability of the five cycles of a nuclear power plant are com-

pared. Equipment costs considered were for only those items that vary with each case. Items common to all cases were omitted. Variable items considered are: reactor and its auxiliaries (referred to as the nuclear island); steam turbine; feedwater heaters; boiler feed, condensate pumps, and associated drives; circulating water pumps and condensers; and piping. The results indicate that superheat steam temperatures in the order of 250°F are economically justified at all fixed charge rates. The grains, however, are more for the higher fixed charge rates. Superheated steam in the order of 450°F can not be justified at any fixed charge rate with present-day boiling water reactors unless new low-poison cladding materials are developed. With pressurized water reactors, 450°F superheat may or may not be justified depending on the amount of cladding required. With stainless-steel cladding of greater thickness than that required for zero superheat, the increased amount of stainless steel leads to greater competition with the fuel for neutrons. To overcome this poisoning effect, the ^{235}U enrichment must be increased as the cladding is made thicker. This results in higher fuel costs for higher superheat. For nuclear superheat, stainless-steel-clad fuel elements are now used. The trend in cladding is in the direction of Inconel, which has an even greater poisoning effect than stainless steel. Raising the steam pressure to 2000 psig shows a steady increase in economic advantage at all fixed charge rates. These gains appear to be higher than those for superheat, and, therefore, the first logical step in future designs would be to raise pressures. (TCO)

35632 SMALL-SCALE THERMOCOUPLES FOR MEASURING TEMPERATURE IN THE REACTOR OF THE FIRST ATOMIC POWER STATION. Subbotin, V. I.; Krivtsov, V. A.; Pokrovskii, Yu. N.; Ibragimov, M. Kh.; Kharitonov, N. P. Teploenergetika, No. 5, 91-4(May 1965). (In Russian)

Microthermocouples having a cross section of less than 1 mm do not disturb the temperature field prevailing near the hot junction; they have a low inertia and make it possible to measure the temperature at otherwise unaccessible locations. In using such thermocouples at the reactor of the First Atomic Power Station, care was taken to provide reliable contact with the surface to be measured. Hydrophobic silicone coating was found to prevent attack by the coolant; in addition, capillary stainless steel, Cu, and Ni tubes were used for cladding. The fully or partially clad thermocouples were used for measurements within the core. During the period from 1960 to 1963, more than 100 stainless steel-clad thermocouples were used. Thermocouples have been operated successfully for more than 10,000 hr at 340°C; in the superheated channels, the prevailing temperature was 500°C. Temperature distribution measurements were carried out with microthermocouples, making contact in drill holes filled with graphite powder and aquadag. Chromel–alumel thermocouples were found to operate reliably under condition of complete leaktightness under a pressure of 100 atm for measuring water temperatures for 680 hr while exposed to a total neutron flux of 5.4×10^{19} n/cm^2. Difficulties may be caused by radiation-induced physico-chemical changes, causing loss of homogeneity in the thermocouple, because of the formation of new radioisotopes. (TTT)

35633 VODNYI REZHIM TEPLOVYKH ELEKTROSTANTSII (OBYCHNYKH I ATOMNYKH). (Water Circuit in Thermal Power Stations (Ordinary and Nuclear)). Margulovaya, T. Kh., ed. Moscow, Isdatel'stvo Energiya, 1965. 384p.

Problems of the water–steam regime of both ordinary and atomic thermal power stations are discussed, for the whole assembly and for the separate parts, e.g., boiler units, reactors, steam generators, turbines, condensers, and preheaters. Performance data and results of recent experimental work are presented. The book is designed for both operating and pilot plants. Subjects discussed include corrosion of construction materials, the condenser as a source of feed water impurities, normalization and calculation of feed water composition, contamination of saturated steam by soluble inorganic substances, steam separation, the superheater and turbine, precipitation on the steam-gengerating and heat-exchange surfaces, and the organization of the operation (e.g., methods and frequency of equipment cleaning and steam cleaning). Numerous figures; approximately 200 references. (TTT)

35634 RADIATION DAMAGE IN FAST REACTOR COMPONENTS. Bush, Spencer H. (Battelle-Northwest, Richland, Wash.); Moteff, John; Weir, James R. p.170-93 of ANS-100.

The combined effects of reactor environment and neutron flux are of major interest to the fast reactor designer. These effects in cladding and structural components are reviewed. Materials are considered in terms of their use in current and future generations of fast reactors. The effects of environment (water, liquid metal, gas), neutron flux spectra, temperature, and thermo-mechanical interactions have been assessed in establishing optimum materials for cladding and structural components. Materials considered include steels, nickel-base alloys, zirconium or titanium alloys, and refractory metals. Each has an application in some form of fast reactor. Specific changes in mechanical and physical properties are considered insofar as they influence the use of a material in a reactor. Where possible, radiation effects in terms of fast neutron exposure are cited. However, due to the virtual absence of information pertaining to irradiation of materials in fast reactors, it has been necessary to base many opinions on information obtained in thermal reactors. The behavior of fuel cladding and structural components is reviewed on the basis of possible effects of irradiation damage, induced stresses, and reactions with fuel and environment as they influence the selection of these materials and establish their probable life. (auth)

35635 MAJOR COMPONENTS AND TEST FACILITIES FOR SODIUM SYSTEMS. Morabito, J. J. (Atomic Power Development Associates, Detroit); Savage, H. W. p.308-32 of ANS-100.

Design features and descriptions are given for pumps, heat exchangers, steam generators, and developmental facilities for fast reactors. (T.F.H.)

35636 FAST REACTOR FUEL HANDLING. Koch, L. J. (Argonne National Lab., Ill.). p.333-47 of ANS-100.

Fuel handling in fast power reactors affects power cost, by virtue of its effect on total fuel inventory and plant availability factor. There is only limited applicable experience available with operational systems; the EBR-II and Fermi reactor fuel handling systems are the first to address themselves to all the problems inherent to fast power reactors. This experience has confirmed the difficult nature of fuel handling operations; it has also shown that the operations can be performed satisfactorily. Other systems are being evaluated which reflect possible modes of reactor operation different than those assumed as the basis for the EBR-II and Fermi fuel handling systems. (auth)

35637 SODIUM TECHNOLOGY FOR FAST REACTOR APPLICATION. Lockhart, Robert W. (General Electric Co., San Jose, Calif.). p.348-9 of ANS-100.

The state of the art of Na technology (impurities, purity control, materials compatibility, etc.) is demonstrated to be sufficient for the use of Na as the coolant for fast reactors operating in the 900 to 1000°F region. (T.F.H.)

35638 MATERIALS SELECTION FOR FAST REACTOR APPLICATIONS. Shoudy, A. A. Jr. (Atomic Power Development Associates, Inc., Detroit); Allio, R. J. p.350-61 of ANS-100.

A review of structural, control, and shielding materials is made. The summary of the structural materials used in the existing fast reactors as well as those projected for the future reactors is presented. The known effects of sodium impurities on the mechanical properties of various structural materials are discussed together with a discussion of the pertinent properties on which to base materials. The cavitation resistance of materials subject to flowing

liquid systems is discussed. The discussion on control materials centers on the use of boron as a poison. The pertinent properites of various boride compounds are reviewed with particular emphasis on boron carbide, the only poison material used to date in fast reactors. The various shield materials used in existing reactors are summarized. Particular emphasis is placed on the mechanical and physical properties and radiation stability of the less common materials including serpentine rock, calcium borate, and boronated graphite. (auth)

35639 WORLD NUCLEAR MARKETS AND THE CANADIAN EQUIPMENT MANUFACTURER. Toronto, Canadian Nuclear Association, 1965, Preprint No. 65-CNA-217, 26p. (CONF-650515-3). ORINS

From International Conference and Exhibition of Canadian Nuclear Assn., Quebec.

A description is given of the components of the CANDU-type reactor. Some of these include main and auxiliary heat exchangers, pumps, piping and fittings, ventilating and cooling equipment, and special steel fabrications. A market forecast is also given. (J.F.P.)

35640 VALVES FOR NUCLEAR SERVICE IN POWER SYSTEMS. Hose, Alexander V.; Prescott, Norman F. (Atwood and Morrill Co., Salem, Mass.). 8p. (CONF-650429-1)

From American Power Conference, Chicago.

The basic requirements and descriptions are given of the following valves used in boiling water and pressurized water reactors: reactor valves, which are associated with the control and operation of the reactor and the primary steam generating system; isolation or safety system valves, which seal or isolate the containment vessel to protect against any escape of radioactivity; and turbine values, which control the operation of the turbogenerator and its auxiliary equipment. Valve requirements for gas-cooled and liquid metal-cooled reactors are also considered. (L.B.S.)

35641 IMPROVEMENTS IN OR RELATING TO HANDLING DEVICES HAVING MOTOR-OPERATED JAWS. Millot, Jean; Mulot, Pierre (to Commissariat a l'Energie Atomique). British Patent 988,283. Apr. 7, 1965. Priority date Feb. 3, 1961, France.

A handling device having gripping jaws is designed to allow the opening or closing of the jaws only at the precise moment at which the device is located within a well-defined working area. A driving pinion and a driven pinion in the gear train controlling the jaws can be decoupled to prevent movement of the jaws. The device is particularly intended for loading or unloading fuel elements into or out of a reactor. (A.G.W.)

35642 A NUCLEAR REACTOR. (to Licentia Patent-Verwaltungs GmbH). British Patent 988,412. Apr. 7, 1965. Aug. 26, 1960, Germany.

The pressure vessel of a reactor, which is cooled and/or moderated by water, is arranged inside an outer casing. The outer casing is lined with a solid compressible medium, preferably a porous plastic material, and contains a store of water in separate tanks arranged to surround the pressure vessel. The lining of the casing and the water tanks may be arranged to form a biological shield. In the event of fracture of the pressure vessel, the compressible lining absorbs the immediate pressure peak, the water tanks burst under the increased pressure, and the water condenses the escaping steam. (A.G.W.)

35643 IMPROVEMENTS IN OR RELATING TO ARRESTER DEVICES FOR BODIES CAPABLE OF VERTICAL MOVEMENT WITHIN A SHAFT. Prince, Kenneth; Banks, Robert (to United Kingdom Atomic Energy Authority). British Patent 989,701. Apr. 22, 1965. Filed Apr. 18, 1963.

An arrester device suitable for use in the high-temperature region of a nuclear reactor includes a load-bearing member supported by a suspension member. The two members are interconnected by links pivotable in a vertical plane and having transverse arcuate extensions. Resilient means, such as a compression spring, located between the load-bearing member and the suspension member support the load when suspended. When the suspending force is removed, the resilient means causes relative movement between the members and consequent pivoting of the links so that the transverse arcuate extensions enter into substantially full circumferential engagement with the wall of the shaft. (A.G.W.)

35644 SHIELDING PLUG FOR CLOSING AN APERTURE IN A RADIATION SHIELDING WALL. Lelong, Roger (to Commissariat a l'Energie Atomique). British Patent 990,328. Apr. 28, 1965. Priority date Mar. 7, 1963, France.

The shielding plug patented consists of a tubular body containing a helical shielding plug member made of a material more absorbent to radiation than that of the wall. The total thickness of the helices taken parallel to the longitudinal axis of the plug is such that it ensures protection at least equal to that of the wall. The plug may be constructed of multiple elements, each cast integrally with a corresponding portion of the tubular body and assembled end to end in the aperture. Connection members may be used to allow circulation of fluid through the plug. (A.G.W.)

35645 NUCLEAR REACTORS. Challender, Ronald Scott; Bromley, Derek (to United Kingdom Atomic Energy Authority). British Patent 990,428. Apr. 28, 1965. Filed June 4, 1962.

A coolant sampling system is applicable to high-temperature gas-cooled reactors in which the control rods are arranged to be moved upward to the space above the core, and guide tubes for the control rods depend from shield plugs in access pipes through the pressure vessel and rest on top of the core. Each guide tube has side apertures through which samples of the coolant are drawn to pass upward through an annular passage defined by the control rod and the tube and through drillings in the shield plug to an annular space bounded by the shield plug and the wall of the access pipe. The samples are drawn off from this annular space by a pipeline leading to fission-product detecting apparatus. (A.G.W.)

35646 NUCLEAR REACTORS. Campbell, Ronald Hugh; Challender, Ronald Scott (to United Kingdom Atomic Energy Authority). British Patent 990,429. Apr. 28, 1965. Filed June 4, 1962.

In a nuclear reactor using hexagonal fuel elements clustered so as to be in contact with one another, a full-group fuel assembly of the core consists of six similar sub-group fuel assemblies arranged symmetrically to define a void. Each sub-group consists of 21 fuel elements arranged in a hexagonal group of 19 with two elements added to the side of the group facing the void. The void defines a control rod channel. The innermost fuel element of each sub-group is a dummy and is removable to give access to a lifting device for the assembly. (A.G.W.)

35647 IMPROVEMENTS RELATING TO NUCLEAR REACTOR WITH BURST DETECTOR EQUIPMENT. Campbell, Ronald Hugh (to United Kingdom Atomic Energy Authority). British Patent 991,168. May 5, 1965. Filed May 25, 1961.

Equipment is described for detecting a burst in a pressure vessel containing a nuclear reactor core of the kind cooled by gas under pressure. A movable pressure sensitive element separates two chambers of which one is connected to the reactor pressure vessel and the other has restricted communication with the first. The sudden reduction of pressure in the pressure vessel resulting from a burst takes place more quickly than the restricted communication can equalize the pressure in the two chambers and causes movement of the pressure sensitive element. Movement of the element forms electrical contacts incorporated in trip circuits that automatically shut down the reactor. (A.G.W.)

35648 A CHARGING MACHINE FOR A FLUID-COOLED ATOMIC REACTOR. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 991,479. May 12, 1965. Priority date Apr. 29, 1961, Germany.

A charging machine for a fluid-cooled reactor includes a drum-type fuel element magazine and a duct at one end of the magazine through which a fuel element passes from the magazine to the reactor. The duct can be closed by a slide valve member between the ends of the duct. A cooling system consisting of a circulating pump and a recooler is arranged to minimize the introduction of hot coolant into the charging machine. (A.G.W.)

35649 DEVICE FOR INTRODUCTION OF OBJECTS IN A LEAKTIGHT VESSEL AND FOR WITHDRAWAL OF OBJECTS FROM SAID VESSEL, IN PARTICULAR FOR A NUCLEAR REACTOR REFUELLING FACILITY. Leclere, Bernard; Lemesle, Georges; Vivien, Jean (to Commissariat a l'Energie Atomique). British Patent 995,315. June 16, 1965. Priority date Feb. 28, 1963, France.

A device is described for the introduction of objects into a service chamber and removal of objects, particularly fuel element magazines, from the service chamber of a gas cooled reactor. Means are provided movable along a first shaft to transfer the fuel magazines between the chamber containing the reactor core and a transit compartment, e.g. an elevator. Second means are provided within a second shaft for transferring the fuel magazines between the transit compartment and another station in communication with the exterior of the reactor pressure vessel. Sealing means are provided between the first means and the first shaft and between the second means and the second shaft so that each part of the device may be isolated from either the chamber or the exterior. (B.L.M.)

35650 IMPROVEMENTS IN NUCLEAR REACTORS. (to Societe Anglo-Belge Vulcain S.A.). British Patent 995,646. Priority date Mar. 9, 1961, Belgium.

A neutron-absorbing reactor control rod is described that can be moved hydraulically into and out of the reactor or maintained in any desired intermediate position during operation of the reactor. The rod is maintained in the desired position by differences of pressure existing under operating conditions between different locations inside the vessel enclosing the core. A spring is provided that helps or effects insertion of the rod into the core, and telescopic means are provided to seize the rod. A releasable latching mechanism connects the rod with the telescoping means. Once the rod is inserted in the core and freed from the telescopic means, the spring exerts stress upon the inserted rod to maintain it in position. (B.L.M.)

35651 COATING COMPOSITION FOR NUCLEAR REACTOR GAS CIRCUITS. Waddington, Fred Berry; Sutcliffe, Kenneth George (to Associated Electrical Industries Ltd.). British Patent 995,920. Filed Aug. 31, 1962.

A coating composition for the internal surfaces of a reactor gas circuit is made up of poly-n-butyl methacrylate with 3–15 wt % carbon black in an organic solvent, e.g. trichloroethylene or perchloroethylene or a mixture of the two. This composition produces a film that decomposes at 200°C and forms non-corrosive products of high vapor pressure. (B.L.M.)

35652 CONTAINER FOR SAMPLES TO BE IRRADIATED WITHIN A NUCLEAR REACTOR. Recule, Albert; Thome, Paul (to Commissariat a l'Energie Atomique). British Patent 996,046. Priority date May 31, 1962, France.

A container for irradiation of samples in a reactor includes a temperaturing regulating device that maintains the desired temperature within the container regardless of the reactor temperature. The container includes a coaxial thermal insulating tube that surrounds the sample holding chamber and forms a free annular space between the tube and container walls. The tube is provided with ports to permit a distribution of gas circulating between the chamber and annular space, and a slidable valve either opens or closes the ports. The valve movements are controlled by a temperature regulating means that comprises a turbine wheel mounted externally on and to rotate freely on the outside of the container. The turbine wheel is driven by the cooling fluid circulating through the core of the reactor and in turn drives a magnetic rotor located inside the container. The magnetic rotor drives a dynamo of which the armature and field windings are movable relative to each other so that the current produced can be caused to vary. The current variations are registered by the bimetallic strip that operates a connecting rod to the slide valve. (B.L.M.)

35653 NUCLEAR REACTORS. (to Sulzer Freres, Societe Anonyme). British Patent 996,157. June 23, 1965. Priority date June 26, 1961, Switzerland.

A reactor pressure tube is closed at one end and contains a tubular fuel rod and a sleeve made of moderator material disposed between and spaced from the fuel rod and the pressure tube. Means are provided for admitting coolant to the space between the rod and tube. The sleeve divides the coolant into two streams that are recombined at the closed end of the tube and flow together back through the interior of the fuel rod. Preferably, each pressure tube, fuel rod, and sleeve form an integral unit that can be removed or inserted into the reactor as a whole. (B.L.M.)

35654 GRAB MEANS FOR FUEL ELEMENTS OF THE LIKE IN NUCLEAR REACTORS. Ericsson, Stig; Danieli, Henrik (to Allmanna Svenska Elektriska AB). Canadian Patent 708,093. Apr. 20, 1965.

A fuel handling device is described in which the grab organs are locked and released by the weight of the tubes and of the maneuver rod. It consists essentially of an outer tube, an inner tube axially movable in the former and provided on its lower end with a grab head having claws free to rotate, a movable locking means between the two tubes, and a rod for maneuvering the claws. No outer force is needed on the claws which act on the fuel rod. (F.S.A.)

35655 STEAM GENERATING INSTALLATION WORKING WITH THE HEAT OF A NUCLEAR REACTOR. (to Sulzer Freres S.A.). French Patent 1,274,240. Sept. 11, 1961. Priority date Nov. 26, 1959, Switzerland.

The steam generating installation comprises a series of steam generating units working at different pressures and temperatures, the corresponding stages of these units being heated in series by a circulating suitably gaseous reactor coolant and are fed in parallel so that at least the first portions of the economizers of all these units are working at the same pressure. Throttling means serving for the pressure control in the corresponding boiler stages are provided after the first economizer portions. (IIB)

35656 BAKING DEVICE FOR A WINCH OR THE LIKE. (to Commissariat a l'Energie Atomique). French Patent 1,282,059. Dec. 11, 1961. Filed Dec. 6, 1960.

The purpose of the device is to transmit the kinetic energy at the time of instantaneous stopping of a moving body, e.g., a safety rod in a nuclear reactor. A drum is rigidly fixed to a rotary shaft and supports by means of a flexible tie the body to be stopped. A pin integral with the drum cooperates with a lever which rotates freely about the rotary shaft during part of the movement of the pin, which comes to rest at the end of its travel, against a fixed stop. Inside a housing is mounted a free-wheel mechanism actuated by said lever and an elastic coupling which is secured on one hand to the housing and on the other hand to an inertia fly-wheel. The kinetic energy of the body is entirely and non-reversibly transmitted to a fly-wheel, when the pin comes into contact with the stop, by means of elastic coupling and the free-wheel mechanism. (IIB)

35657 PNEUMATIC MEANS FOR BRAKING THE END OF THE FALL OF A REACTOR CONTROL ROD. (to Groupement Atomique Alsacienne Atlantique). French Patent 1,300,805. July 2, 1962. Filed June 15, 1961.

The kinetic energy of a falling control rod is absorbed by pneumatic cushioning means comprising a gas in the lower part of the cylinder and in an outer tank. The control rod is fixed to the piston of a pneumatic jack by means of a hollow rod having holes near its connection points. The longitudinally spacing of the holes is a function of the distance through which the control rod falls. An orifice is placed near the base of the cylinder wall of the jack, said

orifice communicating through a non-return valve with a tank provided with a calibrated exhaust orifice. During the accelerated part of the piston fall, the gas is expelled by the piston through the mentioned orifices. Towards the end of the fall, however, the free escape of gas is no longer possible, because it can escape only through the calibrated exhaust of the tank. Thus, the gas under the piston is compressed and slows down the falling. (IIB)

35658 METHOD FOR THE FINE CONTROL OF THE POWER LEVEL OF A SUSPENSION NUCLEAR REACTOR PLANT, WHEN A CONSTANT POWER LEVEL IS REQUIRED. (to Stichting Reactor Centrum Nederland). French Patent 1,308,508. Sept. 24, 1965. Priority date Dec. 30, 1960, Netherlands.

The abnormal fluctuations in the power level of a reactor fueled with a suspension of solid fissile material in ordinary or heavy water are controlled. This is achieved by adding to the suspension a low cross-section water-soluble electrolyte, which affects the hydrogen or deuterium ion concentration. The amount of the electrolyte is such that the abnormal power level fluctuations are reduced or eliminated. (IIB)

35659 RADIO-ACTIVE CHARGE MANIPULATING DEVICE. (to United Kingdom Atomic Energy Authority). French Patent 1,315,403. Dec. 10, 1962. Priority date Feb. 17, 1961, Great Britain.

A nuclear reactor fuel element gripping device forms a unity with a sealing plug. A straight supporting tube carrying a container, extends downwards through the plug. A rod mounted rotatably inside the supporting tube carries a grab on one end of a laterally extending arm. The rotation of the rod causes a lateral movement of the grab which, because of this movement, is placed in alignment with the container. (IIB)

35660 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,315,468. Dec. 10, 1962. Priority date Feb. 21, 1961, Great Britain.

A method of extracting a fuel element from the core as a preliminary to its replacement by another element is described. For access to the fuel elements of the core, at least one hole is provided in the radiation protection screen surrounding the core. The hole is normally closed by a sealing plug. A transportable arrangement is formed by a combination of a sealing plug interchangeable with the normal plug and a gripping device operated by the outer face of the sealing plug for reaching and gripping objects such as fuel elements. Said fuel elements can be lifted into a transit flask and moved out of the reactor by means of a grab arranged on the top of the flask. (IIB)

35661 DEVICE FOR ADJUSTING OF ELEMENTS, ESPECIALLY IN A NUCLEAR REACTOR TANK. (to Commissariat a l'Energie Atomique). French Patent 1,327,941. Apr. 16, 1963. Filed Apr. 13, 1962.

A device for adjusting the position of fuel elements or reflector elements in a nuclear reactor tank is described. The device makes it possible to place a series of fuel elements in position according to the nodes of a lattice having a variable pitch, whether square, rectangular or triangular, inside the tank of a swimming pool reactor. In modifying the arrangement of fuel elements and especially in spacing them, the neutron flux characteristics of nuclear reactors can be modified. (IIB)

35662 TEMPERATURE MEASURING DEVICE. (to United Kingdom Atomic Energy Authority). French Patent 1,330,590. May 13, 1963. Priority date Aug. 11, 1961, Great Britain.

Two examples of temperature measuring of fuel elements in a nuclear reactor are described. In the first example a probe of magnetic material is heated to its Curie point at which temperature the permeability of the probe is at a minimum. The initial temperature of the probe is derived from a measurement of the electrical energy required to heat the probe to its Curie point and a knowledge of the characteristics of the probe and its circuit. In the second example a probe comprises an electrical resistance of material having two temperature-dependent solid phases. The probe is heated, by passage of an electrical current through it, to a transition temperature at which the material changes phase. (IIB)

35663 IMPROVEMENTS RELATING TO NUCLEAR REACTOR FUEL ELEMENTS HANDLING DEVICES. (to Societe Indatom et Compagnie des Ateliers et Forges de la Loire). French Patent 1,331,950. June 4, 1963. Filed Mar. 23, 1962.

A device for loading or unloading fuel elements in a nuclear reactor is described. By means of a cable a frame supporting a deformable system for guiding the fuel elements is lowered into one of the fuel access tubes which pass through the reactor shield. Selected orientation of the frame is obtained by inserting it in one of a plurality of angularly spaced positions. These positions are determined by conforming cross-sections of the frame and access tube, and abutting a part of the frame against a stop inside the reactor shield as the frame is inserted to cause radial movement of the deformable system to a predetermined extent. The orientation of the deformable system is adjustable relative to the frame by pre-setting means which change the orientation during radial movement of the deformable system. The determination of the amplitude of radial movements effected by the deformable system is accomplished by the adjustment of position of a cam which limits the opening of the system according to the co-ordinates of the fuel channel to be serviced. (IIB)

35664 IMPROVEMENTS RELATING TO NUCLEAR REACTOR FUEL ELEMENTS HANDLING DEVICES. (to Societe Indatom et Compagnie des Ateliers et Forges de la Loire). First Add. 82,182 to French Patent 1,331,950. Nov. 25, 1963. Filed Aug. 23, 1962.

Orientation of the frame of the handling device is selected by inserting it in one of a plurality of angularly spaced positions determined by conforming cross-sections of the frame and access tube, and abutting a lower part of the frame against a stop inside the reactor shield as the frame is inserted to cause radial movement of the deformable system to a predetermined extent. A combined assembly of a gripper and a fuel element is placed inside a protective carriage which is maintained in the supporting frame by the upward tractive force applied on a cable. In order to permit the radial movement of the carriage, the deformable system is composed of two link-rods having the same length. The two link-rods are pivotally attached to the supporting frame and the carriage in such a way that the combined assembly of link-rods, supporting frame and carriage define a deformable parallelogram. In as much as the length of the link-rods are predetermined, the bottom portion of the carriage comes into position directly above the channel which has been selected. (IIB)

35665 IMPROVEMENTS RELATING TO NUCLEAR REACTOR FUEL ELEMENTS HANDLING DEVICES. (to Societe Indatom et Compagnie des Ateliers et Forges de la Loire). Second Add. 83,066 to French Patent 1,331,950. Apr. 27, 1964. Filed Feb. 5, 1963.

The system is constituted by two tubular link-rods which are pivotally attached respectively at one of their extremities to brackets on the supporting frame. At the other extremities thereof, the link-rods support by means of pins a protective carriage that contains the fuel elements and which makes it possible by virtue of the radial movement of the deformable system to set the device in a suitable position. The supporting frame and the tubular link-rod are open on the side so as to permit the release of the carriage at the time of outward expansion of the system. (IIB)

35666 IMPROVEMENTS RELATING TO NUCLEAR FUEL ELEMENTS HANDLING DEVICES. (to Societe Indatom et Compagnie des Ateliers et Forges de la Loire). Third Add. 83,066 to French Patent 1,331,950. May 25, 1964. Filed Feb. 8, 1963.

A safety system, which prevents any possibility of the fuel element being released during the movement of the

deformable system is described. This locking system is mounted on the protective carriage and consists of a pair of tongs which is extended at the bottom by an external forkshaped component. The pair of tongs and component are pivotally mounted on the carriage. In the unlocking position, that is to say in the position that corresponds to the outward extension of the deformable system and to moving of the carriage into contact with the top extremity of a channel of the reactor, the pair of tongs pivots about its pin and permits the gripper and the fuel element to pass out freely. On the other hand, in any other position, when the forkshaped member is not applied against the extremity of a channel, the pair of tongs prevents any possible downward movement of the fuel element. (IIB)

35667 STEAM GENERATOR ESPECIALLY FOR NUCLEAR POWER PLANTS. (to Maschinenbau-A.G. Balke). French Patent 1,332,116. June 4, 1963. Filed June 1, 1962.

A steam generator that comprises tubes for the passage of the heating fluid and allows a simple control of the quality of the welds of the tube ends with their headers is described. The tube ends are connected to the outer wall of the double walled headers of annular or polygonal horizontal cross section. The inner walls of the header are connected to the respective outer walls after these welds have been made and their quality was examined by endoscopy or radiography. Preferably these annular headers are coaxially arranged in the vertical axis of the steam generator so that the heating tubes are in the annular interspace between the headers and the steam generator casing. A vertical central duct passes through the headers and serves for the reflux of the working medium. (IIB)

35668 NUCLEAR REACTOR CHARGING DEVICE. (to The English Electric Co. Ltd.). French Patent 1,333,052. June 10, 1963. Priority date Sept. 6, 1961, Great Britain.

A rotatable charge tube is adapted to engage the ends of the fuel channels disposed on two concentric circles. A mobile shutter is disposed inside the charge tube and can be shifted in two positions. When in the first position, the fuel elements are guided to or out of the fuel channels placed on one concentric circle and when in the second position the shutter guides the elements to or out of the channels of the other circle. The shutter is actuated by a follower that moves along a guide-plate placed concentrically between the circles. (IIB)

35669 AUTOMATIC HANDLING GRAB. (to Commissariat a l'Energie Atomique). French Patent 1,334,480. July 1, 1963. Filed June 28, 1962.

A mobile means can move axially inside a hollow body carrying jaws which are articulated by eventual movements of the mobile means. A notched cam, axially immobilized but rotating freely around the mobile means, cooperates with lugs provided at regular intervals inside the hollow body in order to induce release or maintain the charge. The locking mechanism cannot be released accidentally if the fuel element becomes locked or jammed during its movement down the charge path. (IIB)

35670 TRANSFERRING DEVICE FOR IRRADIATED FUEL ELEMENTS. (to Commissariat a l'Energie Atomique). French Patent 1,335,149. July 8, 1963. Filed July 6, 1962.

Fuel elements irradiated in a reactor are transferred from a first receptacle placed on a higher level of the storage pool to the reception boxes fixed at the bottom of the pool. This operation is carried out by a transfer device made up of a console attached to the wall of the pool and supporting a vertical column. This column is able to rotate around its axis. By means of cables and pulleys a vertically mobile arm carrying a tubular housing for fuel elements, can be moved along the column. The transfer is carried out in rotating the column axially and in raising and lowering the mobile arm along the column. (IIB)

35671 DETACHABLE ELECTRIC CONNECTING DEVICE. (to Commissariat a l'Energie Atomique). French Patent 1,336,234. July 22, 1963. Filed July 16, 1962.

An electric connecting device comprises an element secured to the wall of a nuclear reactor channel and another tubular detachable element disposed in the channel. The element secured to the wall of the channel has a fixed contact device with a diameter substantially the same as the channel. The detachable element is made of two parts which are relatively movable along the axis of the channel; the outer part has contact fingers pivotally mounted and urged by resilient means toward the fixed contact while the inner part comprises prehensile means for the manipulation of the assembly. (IIB)

35672 NUCLEAR REACTOR FUEL MANIPULATION DEVICE. (to General Dynamics Corp.). French Patent 1,337,829. Aug. 12, 1963. Priority date Aug. 2, 1961, United States.

A charging and discharging arrangement for a continuously operating power producing nuclear reactor, is designed. A shielded enclosure outside the reactor containment, is disposed on a movable carriage. This enclosure is provided with a central cylindrical channel for temporary storage of new or spent fuel elements which are manipulated by a hoisting and grabbing device. A spent fuel canning chamber is situated within the upper part of the concrete shielding underneath the shielded enclosure. The spent fuel elements are lowered into cans which are then sealed by electro inductive means. (IIB)

35673 CHARGING DEVICE FOR NUCLEAR REACTOR FUEL. (to The English Electric Co. Ltd.). French Patent 1,339,777. Sept. 2, 1963. Priority date Nov. 7, 1961, Great Britain.

A device for charging the fuel elements in nuclear reactor channels is described. The fuel is aligned to form a chain of elements, which are to be introduced in a vertical channel. Each element can be supported by another placed underneath. In order to keep the elements together in a vertical position, the lower end of the chain comprises attaching means for a number of supporting cables such as to permit automatic liberation of the cables when the elements come into working position. (IIB)

35674 GRIPPING DEVICE. (to Commissariat a l'Energie Atomique). French Patent 1,342,267. Sept. 30, 1963. Filed Sept. 26, 1962.

A gripping device is constituted by two members, one of which is carried by the control cable and can be released from the other if the latter jams. The device can then be re-equipped with a new member without any need to withdraw it from the reactor. The gripper body has automatically operated jaws, an end part provided with means for raising and lowering the device, and a coupling device for connecting the gripper body with the end part. The coupling device can be disconnected by applying to the gripping device a tractive force greater than a pre-determined valve. (IIB)

35675 HANDLING GRAB. (to Electricite de France). French Patent 1,343,749. Oct. 14, 1963. Filed Oct. 12, 1962.

Description is given of a handling grab with a hollow body wherein an axially sliding means is moving. Solidly attached to the sliding means are ramps cooperating with gripping balls set in radial openings of the hollow body. Suitable means regulate the running of the sliding means resulting in seizing and releasing of the load. The grab can be locked in either position. (IIB)

35676 IMPROVEMENTS IN DEVICES FOR HANDLING FUEL ELEMENTS IN A NUCLEAR REACTOR. (to Societe Indatom et Compagnie des Ateliers et Forges de la Loire). French Patent 1,344, 935. Oct. 28, 1963. Filed Aug. 23, 1962.

A handling device for fuel elements comprises a frame and a deformable system for guiding fuel elements carried by said frame. The frame, adapted for insertion into a fuel access tube passing through the reactor shield, has in conformity with said access tube a cross section determining a plurality of angularly spaced positions in which the frame can be inserted. One portion of the frame forms a stop in

order to center the device with respect to the head of the central channel which is located directly below the access tube. A suitable procedure permits a cut down in the number of charging and discharging operations for a certain channel, avoiding at the same time the blow-out of cartridges by an appropriate counter flow. (IIB)

35677 IMPROVEMENTS IN DEVICES FOR HANDLING FUEL ELEMENTS IN A NUCLEAR REACTOR. (to Societe Indatom et Compagnie des Ateliers et Forges de la Loire). First Add. 83,279 to French Patent 1,344,935. June 8, 1964. Filed Mar. 15, 1963.

A handling device for fuel elements of a nuclear reactor comprises a frame and a deformable system for guiding the fuel elements, which is carried by said frame. The frame, adapted for insertion into a fuel access tube passing through the reactor shield, has in conformity with said access tube a cross-section determining a plurality of angularly spaced positions in which the frame can be inserted. One portion of the frame forms a stop in order to center the device with respect to the head of the central channel which is located directly below the access tube. The purpose of the invention is an improved centering device permitting the positioning of the frame as accurately as possible both in height and rotation and two horizontal directions. (IIB)

35678 IMPROVEMENTS RELATING TO LARGE-SIZED, ESPECIALLY SPHERICAL CONTAINERS. (to Compagnie Francaise d'Entreprises). French Patent 1,345,154. Oct. 28, 1963. Filed Oct. 26, 1962.

Nuclear reactors are often enclosed in large-sized spherical containers, while lock-chambers are provided for the introduction of carriages or similar devices. For preventing stresses, which may arise due to the thermal expansion of the container, the lock-chambers are supported by elastic means which are suitably constituted by a series of rubber discs disposed one above another. The floor constructions within the lock-chambers are supported independently by columns passing through openings in the chamber wall with the aid of tightening bellows. Preferably these columns are arranged coaxially with the elastic supporting means for the chamber. (IIB)

35679 IMPROVEMENTS IN SYSTEMS ASSURING COUPLING OF A CHARGING MACHINE WITH NUCLEAR REACTOR CHANNELS. (to Commissariat a l'Energie Atomique). French Patent 1,347,032. Nov. 18, 1963. Filed Sept. 7, 1962.

The system comprises a mechanical coupling fitted to the end of the reactor channel or another joining element in a manner to balance mechanically the pressure tending to draw back the machine. Elastic means are provided to compensate the longitudinal expansion (dilation) of channels with regard to the charging machine. (IIB)

35680 CONTROL DEVICE FOR A NUCLEAR REACTOR FUELLING SYSTEM. (to Commissariat a l'Energie Atomique). French Patent 1,347,042. Oct. 18, 1963. Filed Sept. 26, 1962.

Optical and electronic means for the remote control of the fuel handling unit as well as means for positioning the unit in servicing relation to a selected channel are provided. All aforementioned means are placed in a servicing chamber defined in the reactor shield. The image furnished by the optical means is compared with a memory stored image causing a particular instrument to stop when the latter has entered a predetermined region. (IIB)

35681 IMPROVEMENTS RELATING TO WATER TUBE STEAM GENERATORS. (to Foster Wheeler Ltd.). French Patent 1,347,937. Nov. 25, 1963. Priority date Dec. 11, 1961, Great Britain.

The steam generator comprises a vertically disposed cylindrical casing through which the heating fluid flows. This heating fluid is the coolant of a nuclear reactor, while the casing encloses a series of uprising water tubes connected at its lower ends to the lower part of a central tube serving for the reflux of the water separated in the water-steam separators. These tubes communicate via their upper ends with a water-steam container disposed at the upper end of the central reflux tube. The container encloses the water-steam separators from which the steam is led downwards through superheater tubes, disposed in the proximity of the inner wall of the cylindrical casing, and finally through a central steam outlet pipe in the bottom of the casing. (IIB)

35682 DEVICE PREVENTING THE BLOW-OUT OF FUEL CARTRIDGES FROM A NUCLEAR REACTOR CHANNEL. (to Electricite de France). French Patent 1,348,573. Dec. 2, 1963. Filed Nov. 29, 1962.

During the discharge of a nuclear reactor channel, the coolant flow progressively increases while the loss of charge decreases due to the withdrawal of the fuel cartridges. When the last cartridges remain alone in position in the reactor, the fuel coolant exerts a force on the cartridges incurring the risk of the latter being blown out. To prevent this, a suitable flow controlling device is incorporated in the charge chute to maintain the coolant flow substantially constant during the whole charging or discharging operation. (IIB)

35683 FUEL ELEMENT HANDLING DEVICE FOR NUCLEAR REACTOR. (to Atomic Energy of Canada Ltd.). French Patent 1,348,867. Dec. 2, 1963. Priority date Oct. 10, 1962, Canada.

To prevent excessive heating of the fuel element handling machine caused by the passage of part of the reactor coolant through a tube connecting it with the reactor channel, the machine temperature is to be maintained below the temperature of the reactor coolant. This is achieved by forcing an auxiliary, especially cooler refrigerant in opposite direction to the reactor coolant blocking its penetration into the machine. (IIB)

35684 NUCLEAR REACTOR CONTROL APPARATUS. (to United Kingdom Atomic Energy Authority). French Patent 1,348,981. Dec. 2, 1963. Priority date Mar. 2, 1962, Great Britain.

A control apparatus for nuclear reactor has a control-rod with a ferromagnetic head. The control-rod is movable between an upper inoperative position and a lower operative position. An electromagnetic grab is capable when energized of holding the control-rod by its head and conveys the control-rod between the aforesaid two positions. The grab has a magnetic coil, a central polepiece of one polarity to contact the end face on the control-rod head, and a plurality of fingers constituting polepieces of the other polarity. The fingers embrace the control-head to complete the magnetic circuit through the head. (IIB)

35685 SAFETY BRAKING DEVICE FOR THE CONTROL ROD OF A NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). French Patent 1,352,881. Jan. 13, 1964. Filed Dec. 13, 1962.

The braking device comprises a support fixed within the reactor structure, a body adapted to be deformed and having suitably a tubular shape. This body is partially embedded in a corresponding groove following an appropriated curve and provided in a cylindrical surface of the reactor structure. A mandrel is fixed to the control rod head and adapted to deform, during its passage through the support, the non-embedded portion of the tubular body. Suitably the tubular body is embedded in a helical groove, the pitch of which may be constant or variable. According to another embodiment the body is subdivided such as to provide a series of hollow torns disposed perpendicularly to the support axis. (IIB)

35686 BIOLOGICAL SHIELD FOR NUCLEAR REACTOR. (to Electricite de France). French Patent 1,352,950. Jan. 13, 1964. Filed Jan. 8, 1963.

A biological shield especially adapted to be placed between the reactor core and a heat exchanger both placed within the same pressure vessel, comprises a metallic framework and one or several metallic elements supported by said framework and disposed in a manner such as to prevent any direct passage of radiation, the free expansion of these elements being possible without deformation of the framework. Preferably the elements of the shield, which may be hollow, enclose a tube system such

as to form a cooling circuit. The shield suitably comprises two parts disposed one above another and interconnected by coupling bolts, the cooling systems of these parts being suitably connected by channels provided within the coupling bolts. (IIB)

35687 NUCLEAR REACTOR. (to The English Electric Co. Ltd.). French Patent 1,353,235. Jan. 13, 1964. Priority date Mar. 19, 1962, Great Britain.

A plurality of neutron-absorbing elements is arranged generally parallel to the fuel elements of a nuclear reactor. The neutron-absorbing capacity of the elements is greater in the longitudinal center portion than in the end portion thereof. The elements can be in the form of stainless wires attached to a suitable part of the fuel element and distributed so as to provide a suitable variation in mass along the channel. (IIB)

35688 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,353,329. Apr. 13, 1964. Priority date Apr. 13, 1962, Great Britain.

A safety means for a fast neutron reactor comprises a layer of moderating material provided with channels under the reactor core. The channels receive the core material in the case of its fusion following an overheating accident. The disposition of that layer is such that the reactivity of the core material after entering said channels is lowered due to the absorption of the neutrons slowed down in the moderating material. Preferably said layer comprises additional neutron absorbing material or the core material comprises a sufficient quantity of thermal neutron absorbing plutonium isotopes. The ends of the channels, which are farthest from the reactor core, are closed, while said channels are suitably divergent in downwards direction and pass the whole thickness of the layer. (IIB)

35689 PROCESS AND DEVICE FOR CONTROLLING THE REACTIVITY OF A NUCLEAR REACTOR. (to A.F.R. Peyron). French Patent 1,355,718. Feb. 10, 1964. Filed Feb. 6, 1963.

The process for controlling the reactivity of a nuclear reactor consists in placing a neutron reflecting system round the reactor core and in changing the characteristics of this reflecting system. According to a first embodiment the reflecting system comprises a series of swivelling shutters. According to a second embodiment the reflector is a liquid, the level of which may be controlled. A third embodiment provides a series of gas filled cells the gas pressure of which may be controlled. In a last embodiment the reflector system is provided with cells or pores which may be filled with a gas or a liquid. (IIB)

35690 PROCESS FOR CONTROLLING THE REACTIVITY OF A NUCLEAR REACTOR AND CONTROL ELEMENTS OF VARIABLE CROSS SECTION FOR CARRYING OUT THIS PROCESS. (to Communaute Europeenne de l'Energie Atomique (EURATOM)). French Patent 1,356,074. Feb. 10, 1964. Priority date May 11, 1962, Italy.

The reactivity control is performed by placing control elements within the reactor core and in changing in an essential continuous manner the transversal dimensions of said control elements. According to a first embodiment such a control element is constituted by a telescopic assembly of independent tubes disposed at the same level within the reactor core. For reducing the anti-reactivity the outer tube is lifted, after its complete withdrawal from the reactor core the next tube follows in the same manner. According to a second embodiment the control element is constituted of a bended plate such as to form a hollow cylindrical body, open at its ends and provided with an inwardly folded portion fixed to a central support adapted to rotate such as to wind up the plate, which finally has the shape of a narrow wound spiral. (IIB)

35691 PRESSURIZED NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,360,055. Mar. 23, 1964. Priority date May 30, 1962, Great Britain.

Cables for the connection of thermocouples are disposed inside the reactor pressure vessel with temperature recorders disposed outside. The cables are led through the wall of the reactor pressure vessel through the medium of the cover which seals off an opening providing access to the interior of the pressure vessel. On the opposite sides of the cover are disposed seals between each cable and the cover, and means for providing fluid access to the interspace between the seals. (IIB)

35692 CONTROL ARRANGEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,360,064. Mar. 23, 1964. Priority date June 4, 1962, Great Britain.

A nuclear reactor comprises a core structure housed within a vessel. The control rods are supported from below the structure and are movable into a space above the structure, said vessel having branch pipes which penetrate the shell thereof from above the core structure for access to the structure. The branch pipes are closed by plug members carrying control-rod guiding means of extensible tubular form. Thus, the problem of guiding the control rods as they emerge from the upper face of the core structure is resolved and means are provided which will avoid hindrance to the discharge of the columns. (IIB)

35693 FLUX MEASURING SYSTEM FOR A NUCLEAR REACTOR. (to Westinghouse Electric Corp.). French Patent 1,363,980. May 11, 1964. Priority date Apr. 18, 1962, United States.

A flux measuring system for a nuclear reactor utilizes a column of balls or other suitably shaped pellets made of a flux sensitive material. This material is introduced into and withdrawn from a reactor by means of a fluid. After their withdrawal from the reactor the activation of the balls or pellets is measured which permits the detection of flux distribution within the reactor core. (IIB)

35694 IMPROVEMENTS IN REMOTELY SUPERVISED MANIPULATION OF INACCESSIBLE OBJECTS. (to Societe Alsacienne de Constructions Mecaniques et Societe de Transactions Commerciales et Industrielles entre la France et l'Allemagne). French Patent 1,366,784. June 8, 1964. Filed Apr. 5, 1963.

To supervise the manipulation of objects placed in the channels of a nuclear reactor, a television camera can be used. However, the camera is rapidly deteriorated because of the radiations and heat arising from the manipulated objects. According to this patent the camera, which is housed in a leak-tight box comprising also an automatic gripping device is placed at a distance from the object. Between the object and the camera is an endoscope. (IIB)

35695 CONTROL EQUIPMENT FITTED WITH MULTIPLE TWO-WAY VALVES IN GAS SAMPLING SYSTEMS OF A GAS-COOLED NUCLEAR REACTOR. Harper, Cecil; Hosegood, Samuel Brittan; Mitchell, Eric James (to Euratom). German Patent 1,187,746. Feb. 25, 1965. Priority date Dec. 9, 1960, Great Britain.

A sampling device is described in which two-position values communicate the inlet ducts of the valved assembly normally with a source of flushing gas and selectively with a sampling location. The valves are mounted so that one port of each valve lies in a common circle with the other ports of alternate valves lying on concentric circles with radii greater and lesser than that of the common circle. The ports on the common circle are aligned with axially extending valve rods which move axially to control flow through the ports. (D.C.W.)

35696 STORAGE VESSEL FOR SOLID LOADING ELEMENTS FOR NUCLEAR REACTORS. Braun, Helmuth (to Brown, Boveri and Cie. AG). German Patent 1,190,591. Apr. 8, 1965. Filed Jan. 2, 1958.

A storage vessel to be mounted on top of the reactor is described in which solid elements of fuel, fertile material, or moderator with cylindrical or spherical shapes can be held for loading. The vessel has at least one spiral passage for guiding the elements, which are introduced at the top

of the spiral and are discharged singly at the bottom. (D.C.W.)

35697 MODERATOR STRUCTURE OF A NUCLEAR REACTOR. Mueller, Arno (to Deutsche Babcock and Wilcox). German Patent 1,190,592. Apr. 8, 1965. Filed Oct. 14, 1961.

A moderator structure is described, which comprises an assembly of blocks of solid material, each block being substantially symmetrical in cross section about a central axis in the block, the distance between the central axis of each block being maintained constant within predetermined limits by a system of vertically arranged supporting surface formed in the sides of the blocks and running in the direction of the central axis, so that the surfaces of any one block and the adjacent blocks lie in three different planes containing the central axis. The supporting surfaces are arranged in such a way that the surfaces of adjacent blocks face each other. (Gmelin Inst.)

35698 REACTOR LEAK DETECTOR USING FILTERS. Jacobs, Ivan M. (to General Electric Co.). U. S. Patent 3,178,355. Apr. 13, 1965. Filed Oct. 9, 1961.

A system for detecting and identifying defective fuel elements in a reactor is based upon passing a sample of fluid flowing adjacent a given fuel element through a solid filter to filter particulate matter from the sample. Subsequent monitoring of the filter detects any radioactive material from a leaking fuel element. In large systems multiple filters are used. The system may be arranged either for continuous monitoring or for monitoring only at desired intervals. Accumulation of particulate matter in filters permits detection of small defects. (A.G.W.)

35699 HYDROCARBON MODERATOR-COOLANTS FOR NUCLEAR REACTORS. Black, James F.; Mackinnon, John (to Esso Research and Engineering Co.). U. S. Patent 3,178,357. Apr. 13, 1965. Filed July 14, 1961.

A highly aromatic fraction extracted from by-products of conventional refinery processes is heat treated to produce a material suitable for use as a moderator and/or coolant in a nuclear reactor. The extract used boils within the range 700-900°F and is refined to reduce its sulfur content. The treatment consists generally of heat soaking at a temperature of 500-1100°F and a pressure of 0-1000 psig for 0.5-72 hr and removing degradation products boiling above 1100°F. (A.G.W.)

35700 GRAPHITE MODERATED NUCLEAR REACTOR. Weisner, Edward F.; Churchill, John R.; Banks, William F. (to North American Aviation, Inc.). U. S. Patent 3,186,913. June 1, 1965. Filed May 18, 1960.

A core design for a graphite moderated reactor is proposed that significantly reduces the neutron absorbing material in the core, but also removes all the neutron absorbing material from the high flux region at the center of each moderating element. A plurality of solid cylindrical graphite elements of circular cross section are supported in the core tank. Each graphite element is clad, and the elements are arranged on triangular centers to define a plurality of interstices of triangular configuration between the graphite elements. Some of the interstices contain fissionable material fuel elements, and some contain filler elements having a triangular cross section. Cooling means for the reactor include a coolant that circulates through the interstices. (B.L.M.)

35701 CONTROL ROD GRAB DEVICE. Webb, John; Bolton, Owen Hayden (to United Kingdom Atomic Energy Authority). U. S. Patent 3,186,914. June 1, 1965. Priority date Mar. 2, 1962, Great Britain.

Control apparatus for the reactor includes a control rod with a ferromagnetic head and an electromagnetic grab. The control rod is moveable between two positions: an upper inoperative position and a lower position. The electromagnetic grab is movable for reaching the control rod in its two positions; and when the grab is energized, the control rod is held by its head. A central polepiece of one polarity contacts the end face on the control rod head, and a plurality of fingers constitutes polepieces of the other polarity to embrace the control head and complete the magnetic circuit through the head. Preferably the central polepiece is made up of a core wound with a magnetizing coil and a search coil to enable detection of contact between the grab and rod head. The grab may be provided with a spring-loaded pin slidable in a bore through the central polepiece and a solenoid to withdraw the pin into the grab against the spring-loading when the grab is energized. When the grab is de-energized, the pin is sprung into a position in which its end protrudes through the central polepiece to assist disengagement of the rod head from the grab. (B.L.M.)

35702 EXCHANGING MACHINE FOR CONTROL ROD ASSEMBLY IN A NUCLEAR REACTOR. Danieli, Henrik; Moenestam, Eskil. U. S. Patent 3,186,915. June 1, 1965. Priority date June 30, 1961, Sweden.

A machine is provided for exchanging the control rod assemblies of a nuclear reactor, preferably heavy water reactors. The machine includes members for inserting and withdrawing control rod assemblies through openings into the bottom of the reactor, and the members are situated inside a radiation protective casing tightly connectable below the reactor. The casing forms an operating cylinder and is provided with means for performing the following functions: applying all necessary sealing members, disengaging the control rod assembly from the reactor, connecting the assembly to the withdrawing and inserting members, and tightening and loosening a locking member for a sealing plug for the opening into the reactor. To prevent radioactive steam from flowing out from the exchanging machine when it is not connected to the reactor, a valve is provided in the opening of the exchanging machine that is closed before the machine is disengaged from the reactor. (B.L.M.)

Criticality Studies

See also PHYSICS — Criticality Studies.

Refer also to abstracts 35506, 35627, 35752, and 35841.

35703 (BNWL-38) MICROWAVE NEUTRON FLUX MONITORING DEVELOPMENTS. Progress Report, Brown, D. P.; Porter, N. S. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1965. Contract AT(45-1)-1830. 25p. Dep.; $2.00(cy), 1(mn) CFSTI

Microwave in-core neutron flux monitoring experiments were initiated early in 1964 in a water-cooled facility in the Hanford KW-Reactor. Seven different experiments were conducted during the year. Six resonant cavities were developed and used with nitrogen and helium gases, with nitrogen being used only in the initial experiment. Two of the cavities were of the transmission type employing different waveguides for the transmitted and return signals; the others were reaction cavities on a single waveguide with a directional coupler for use in signal acquisition. The reactor in-core tests followed extensive laboratory experiments using different configurations and artificially ionized plasmas. Adverse temperature effects, which caused considerable difficulty in the initial reactor test, were alleviated by improved design of the cavities to provide better cooling. A series of subsequent in-core tests employing reaction cavities established a definite relationship between neutron flux density and cavity resonant frequency when using an excitation frequency of about 30 GHz. A single experiment, using the cross-coupling attenuation concept, was performed and the data demonstrated a promising relationship between the probe position in the reactor core and the attenuation of the transmitted signal. This method had the added advantage of yielding a readout which could be recorded directly from the standing-wave-ratio (SWR) meter. (auth)

35704 (EUR-2181.e) A STUDY OF CELL PARAMETERS USING THE K-7-THERMOS NEUTRON THERMALIZATION CODE. Raajmakers, W. A. (Reactor Centrum Nederland, The Hague). 1965. 48p. Dep.(mn).

The results obtained with the K-7-THERMOS code are presented. This code is specifically designed for neutron spectra and flux calculations in small as well as large reactor cells with cylindrical symmetry and is based on principles by Honeck. A short description of the code itself is given as well as some details related to the theory. The actual calculations were carried out on a Ferranti-Mercury computer. (auth)

35705 (EUR-2416.e) ON A DERIVATION OF THE MULTIGROUP KINETIC EQUATIONS OF COUPLED REACTORS. Schwalm, D. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1965. 24p. Dep.(mn).

Starting from the time dependent Boltzmann equation, a multigroup multipoint kinetics is derived. The coupling parameters are expressed in terms of leakage probabilities, which can be calculated for the stationary state. In particular, it is shown that the well-known concept of a pseudo group of precursors for a reflected reactor cannot be used in a multigroup treatment. (auth)

35706 (LA-3219) CRITICAL ASSEMBLIES OF FISSIONABLE MATERIALS. Mills, Carroll B. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Oct. 1959. Contract W-7405-eng-36. 21p. Dep.; $2.00(cy), 1(mn) CFSTI.

A number of critical assemblies were studied for purposes of reactor safety and criticality evaluation. These were H_2O-moderated ^{233}U, ^{235}U, and ^{239}Pu critical experiments, and D_2O, Be, BeO, and C moderated, enriched ^{235}U critical experiments that provided simple parametrics and extremes in type. The atomic densities and dimensions directly useful for computational purposes are listed for fast-to-thermal-flux spectrum assemblies. (auth)

35707 (LA-DC-6579) BURST BEHAVIOR OF A URANIUM-MOLYBDENUM GODIVA-TYPE REACTOR. Wimett, T. F.; White, R. H.; Pederson, R. A. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1963]. Contract W-7405-eng-36. 10p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

The description of a uranium–molybdenum reactor, similar to the Godiva II, is included. A study of the burst behavior is presented. Diagrams show burst temperature rise at the hottest point plotted against reciprocal period as measured early in power rise, and peak power and burst width at half maximum as plotted against reciprocal period. (M.O.W.)

35708 (UJV-1310/65) FLAT FLUX IN A SLAB REACTOR WITH NATURAL URANIUM. Bartosek, V.; Zezula, R. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1965. 20p. Dep.(mn).

On the basis of two-group theory a nonlinear differential equation for fuel distribution is formulated, which causes a flat thermal flux in a slab reactor with resonance escape probability depending on the density of fuel. An iterative procedure for solving this equation is described, which was employed for numerical calculation of fuel density distribution in a homogeneous slab reactor with D_2O and natural uranium. (auth)

35709 (WAPD-T-1673) NONCONVERGENCE OF STEADY-STATE XENON CALCULATIONS. Margolis, S. G. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Jan. 1964. Contract AT(11-1)-Gen-14. 8p. (CONF-446-85) Dep.(mn); $1.00(cy), 1(mn) CFSTI

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The steady-state distribution of flux in a power reactor is found by simultaneous solution of neutron diffusion equations and the xenon and iodine balance equations. Normally this process converges. In some recent work involving large cores, however, some problems failed to converge. While it is clear that the iterative process does not simulate the actual production of xenon in an operating reactor, the possibility remains that the same factors which produce nonconvergence in a computation may also act to produce oscillation in a real core. An investigation of this possibility is presented. (M.O.W.)

35710 CALCULATIONS OF WEAK AUTO-OSCILLATIONS IN NUCLEAR REACTOR OPERATIONS. Torlin, B. Z. At. Energ. (USSR), 18: 463-8(May 1965). (In Russian)

An approximate method of calculations was suggested for small-amplitude reactor reactivity auto-oscillations. An equation was obtained for evaluating, within the approximation limitations, the frequency of reactor auto-oscillations, reactivity oscillation amplitudes, and the power and phase difference between the oscillations. (tr-auth)

35711 DETERMINATION OF INTEGRAL FLUX DENSITY OF FAST NEUTRONS BY NICKEL- AND TITANIUM-DETECTORS. Koehler, W. (Technische Hochschule, Munich). Atomkernenergie, 10: 173-6(May-June 1965). (In German)

The determination of the integral flux density of fast neutrons by activation detectors is reported. Some results with the $^{58}Ni(n,p)^{58}Co$ and $^{46}Ti(n,p)^{46}Sc$ threshold reactions are given. The change of physical properties by neutron irradiations is in better agreement with the measured integral flux density (even if the configuration of fuel elements is changed) than with the irradiation time. Effective cross sections of the mentioned reactions for the flux density distribution within the core of a light-water-moderated reactor are given. These cross sections are necessary for further measurements and the comparison with irradiations in other reactors. (auth)

35712 SAFETY PROBLEMS IN ELECTRICAL CIRCUITRY FOR NUCLEAR REACTOR SAFETY SYSTEMS. Reik, M. (Technischer Ueberwachungs-Verein Bayern e.V., Munich). Atomkernenergie, 10: 181-5(May-June 1965). (In German)

Special circuitry is required on electrical circuits to increase reliability in reactor safety systems. A review of today's circuit philosophy is presented. The problem of real multi-channel-instrumentation and system testing during reactor operation is discussed. Solid-state devices offer new aspects for reliability. The main features of the technique and a generalized circuit of a self-testing system is described. (auth)

35713 A SEMI-ANALYTICAL EVALUATION OF DIFFUSION COEFFICIENTS OF REACTOR LATTICES USING THE MONTE CARLO METHOD. Marti, J. T. (Therm-Atom Ltd., Winterthur, Switzerland). J. Nucl. Energy: Pt. A & B, 19: 439-45(June 1965).

Although defined for the general case, the calculation method for diffusion coefficients of reactor lattices given by Benoist has until now been evaluated only for the one-dimensional case of circular cylindrical systems of few concentric zones which may consist of vacuum. An evaluation for diffusion coefficients of systems whose material constants depend on two dimensions is given. Based on the general formalism of Benoist the fundamental expression is reduced analytically and the residual multiple integrals are estimated by Monte Carlo methods. Diffusion coefficients of a 5-zone one-dimensional case with two air gaps and of 7-rod cluster elements in the Lucens reactor are computed. Since a few hundred histories give sufficient accuracy, the calculation time on a computer for one diffusion coefficient is small. (auth)

35714 THEORY OF NEUTRON THERMALIZATION IN A CYLINDRICALLY SYMMETRIC TWO-ZONE REACTOR CELL. Kuesters, H. (Kernforschungszentrums, Karlsruhe, Ger.). Nukleonik, 7: 130-44(Mar. 1965). (In German)

The position and energy-dependent neutron distributions in the thermal and epithermal energy ranges were determined by analytical methods for a cylindrically symmetric two-zone unit cell. The moderator was treated, with respect to its scattering properties, as a monoatomic gas of mass M. In the moderator and fuel zone, 1/v absorption was assumed. The epithermal solution was determined by development of the neutron distribution according to powers

of $1/\sqrt{\epsilon}$ ($\epsilon \equiv E/kT$). In the thermal region, the formulation of a system of orthonormal functions sufficiently extensive for the thermalization problem led to a rapid convergence of the method. In the numerical evaluation, a discussion was made of which parameters are especially significant for the thermalization problem in heterogeneous systems. The effect of anisotropic scattering of neutrons in the moderator was discussed. An estimation was made of how far the spectra calculated in the P_1 approximation can deviate from the rigorous solutions. (tr-auth)

35715 ON THE BOUNDARY CONDITIONS WITH ISOTOPIC REFLECTION FOR CALCULATION OF THE CYLINDRICAL CELL BOUNDARY. Fukai, Yuzo (Nippon Atomic Industry Group Co., Ltd., Tokyo). Nukleonik, 7: 144-52(Mar. 1965). (In German)

An exact method for calculating the collision probability of neutrons in the effective lattice of fuel rods as well as the neutron flux distribution was reported previously. By comparison with this method, the accuracy of a method in which approximately the exact boundary conditions were replaced by isotropic reflection at the cylindrical cell boundary was discussed. The collision probability in a two-zone lattice with the boundary condition with isotropic reflection was derived, and the physical interpretation of the approximation was discussed. For two-zone lattices, it was established that the approximation of Nordheim is better than the above-mentioned approximation. For the rigorous calculation of the multizone lattice, there is no suitable method. The application of the approximation with isotropic reflection, however, yields relatively good results although it yields a smaller neutron flux distribution than the exact method. The relation between the neutron flux inclination at the cylindrical cell boundary and the boundary condition with isotropic reflection was discussed. (tr-auth)

35716 LOCAL KINETIC EQUATIONS OF A REACTOR. Mueller, Karl-Heinz (CCR EURATOM, Ispra, Italy). Nukleonik, 7: 202-4(Apr. 1965).

Very heterogeneous reactor compositions require space- and energy dependent kinetic equations to describe the time behavior of the neutron flux with sufficient accuracy. By using a suitable stationary flux distribution such a set of equations can be constructed. (auth)

35717 ON ANALYTICAL DESCRIPTIONS OF NEUTRON TRANSPORT. Mueller, Karl-Heinz (CCR EURATOM, Ispra, Italy). Nukleonik, 7: 204-7(Apr. 1965).

The neutron flux $\Phi(r, v, t)$ in any reactor can be represented exactly by an expansion $\Phi = \Sigma\varphi_k\psi_k$ into a complete system of functions ψ_k, arbitrarily chosen, but well defined for all values of their arguments. In general, such a representation of Φ reduces the procedure for solving the Boltzmann equation to the evaluation of a system of integro-differential equations in the coefficients φ_k. These reduced Boltzmann equations can be interpreted as Euler equations of different functionals. Regarding the reactor and its surroundings as a heterogeneous continuum, the usual surface conditions can be replaced by continuity conditions and the criticality condition by a criterion of asymptotic stability. (auth)

35718 REACTOR KINETICS EQUATIONS ACCORDING TO P_1-APPROXIMATION. Gencay, Sarman (Atomic Energy Commission, Istanbul). Nukleonik, 7: 208(Apr. 1965).

The reactor kinetics equations are deduced according to P_1-approximation developed by A. Y. Ozemre. (auth)

35719 PHYSICS. Power Reactor Technol., 8: No. 2, 109-25(Spring 1965).

Various reports of results of critical and exponential experiments are described. Measurements and calculations of neutron age and diffusion length are reviewed. Measurements of neutron cross sections in various isotopes are cited. Discussions of neutron thermalization and the scattering-law formulation are mentioned. 28 references. (M.J.T.)

35720 CROSS SECTIONS FOR REACTOR CALCULATIONS. Vreeland, John A. (Aerojet-General Corp., Azusa, Calif.). p.426-42 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

Some of the characteristics of neutron cross sections are outlined, together with methods of using them. The analytical description of resonances is covered, together with methods for producing spectrum-averaged cross sections. (D.C.W.)

35721 THE CALCULATION OF REACTIVITY AND TEMPERATURE CHANGES FOLLOWING A DISTURBANCE IN REACTOR CONDITIONS. Smith, D. C. G.; Rowlands, J. L. (U.K.A.E.A. Winfrith, Eng.). p.194-212 of ANS-100.

Calculational methods for Doppler and coolant reactivity coefficients in fast reactors are presented. Multigroup methods for small changes are outlined. Uncertainties in the calculations are noted. The ranges of temperature coefficients to be expected in kinetic studies are tabulated. Approximate methods for calculations of transients are given. Difficulties in experimental evaluation of coefficients are considered. (T.F.H.)

35722 FAST REACTOR STABILITY AND SAFETY. Nims, John B. (Atomic Power Development Associates, Inc., Detroit). p.213-24 of ANS-100.

Analyses are presented of operational stability, plausible reactivity-insertion accidents, accidents owing to heat-removal deficiencies, and maximum hypothetical accidents in liquid-metal-cooled fast reactors. (T.F.H.)

35723 REACTOR PHYSICS. p.111-19 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Research is reported in the areas of neutron utilization in reactors, lattice geometries for reactors, and reactor shielding. (T.F.H.)

35724 REACTOR CONTROL BY SPACING OF FUEL. Blake, Leslie Reginald (to United Kingdom Atomic Energy Authority). U. S. Patent 3,180,799. Apr. 27, 1965. Priority date Jan. 12, 1959, Great Britain.

A control system for fluid-cooled reactors is designed to prevent overheating due to loss of coolant or coolant pressure. Fuel element assemblies are held in their normal positions by forces exerted on them by the coolant flow. Loss of coolant or coolant pressure, therefore, releases the fuel assemblies for movement into dispersed positions in which the core is subcritical. (A.G.W.)

Design and Feasibility

35725 FAST REACTOR TECHNOLOGY. AMERICAN NUCLEAR SOCIETY NATIONAL TOPICAL MEETING, DETROIT, MICHIGAN, APRIL 26-28, 1965. (American Nuclear Society, Detroit, Mich.). 364p. (ANS-100 CONF-650417).

Twenty-seven papers are included; separate abstracts have been prepared for 25. Two papers were previously abstracted in NSA, 19: 25705 and 29576. (T.F.H.)

For abstracts of individual papers see: 35574, 35634, 35635, 35636, 35637, 35638, 35721, 35722, 35726, 35738, 35739, 35802, 35803, 35804, 35805, 35806, 35807, 35808, 35809, 35810, 35811, 35812, 35840, 35855, and 35856.

35726 FAST REACTOR CORE ENGINEERING. Friedland, Aaron J. (Atomic Power Development Associates, Inc., Detroit). p.295-307 of ANS-100.

Engineering features of fast reactors are reviewed and contrasted with the corresponding features of thermal reactors. The topics studied include a listing of the characteristics of fast reactors, physics and safety considerations in the engineering design, liquid metal heat transfer, coolant flow and pressure drop, cladding design, and fuel heat transfer. (T.F.H.)

35727 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,350,228. Dec. 16, 1963. Priority date Feb. 7, 1962, Great Britain.

Nuclear reactor installation comprising a liquid coolant serving as moderator and adapted to flow in a closed cir-

cuit through the reactor pressure vessel and a heat exchanger disposed at a higher level than the reactor core is described. The pressure vessel top is in communication with a gas vessel so that the gas pressure may act on the free level of the coolant within the reactor pressure vessel. This pressure has a value sufficient to hold the circuit in starting condition at a minimum temperature. Before starting a sufficient quantity of coolant is filled into the reactor vessel, the air left in the system is then evacuated by a vacuum pump after which a valve is opened so that the pressurized gas may enter into the reactor vessel. (IIB)

35728 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,351,735. Dec. 30, 1963. Priority date Mar. 21, 1962, Great Britain.

A gaseous coolant under pressure is circulated through a reactor core in a pressure vessel. A heat exchanger, a blower, and impeller of the blower are disposed therein so that the diffusing casing of the blower is also within said pressure vessel. This arrangement comprises a shielded flask with an aperture through which an impeller can pass and an impeller support platform so mounted within the flask that it is rotatable about a horizontal axis with an impeller on both sides of the platform. The flask can be sealed about an aperture in a pressure vessel in such a way that the flask registers with that aperture. (IIB)

35729 NUCLEAR REACTOR. (to The Nuclear Power Plant Comp. Ltd. and John Thompson Nuclear Energy Comp. Ltd.). French Patent 1,353,257. Jan. 13, 1964. Priority date Mar. 29, 1962, Great Britain.

A reactor pressure vessel encloses the reactor core disposed in a central compartment, heat exchangers for heating the working fluid by the reactor coolant, and a radiation shield separating the reactor core from the heat exchangers. This radiation shield is provided with a series of channels for the passage of the reactor coolant, the inlet and the outlet of each of these channels not being in alignment, while radiation absorbing dividing walls are disposed longitudinally over the whole length of each channel. The shield is constituted by neutron moderating and thermal neutron and γ ray absorbing materials. Preferably these materials are disposed in alternating layers. Suitably each passage comprises parallel inlet and outlet portions and a middle portion perpendicular to the former. (IIB)

35730 IMPROVEMENTS RELATING TO NUCLEAR POWER PLANTS. (to The Nuclear Power Plant Comp. Ltd. and A.E.I.-John Thompson Nuclear Energy Comp. Ltd.). French Patent 1,355,064. Feb. 3, 1964. Priority date Feb. 28, 1962, Great Britain.

The power plant comprises a nuclear reactor having a core cooled by a pressurized fluid and enclosed within a pressure vessel the wall of which constitutes the biological shield. Preferably the reactor is gas cooled while a concrete pressure vessel is used, the inner surface of which is provided with a steel liner. An annular radiation shield encloses the reactor core within the vessel space such as to form an annular space between that shield and the vessel wall. This annular space encloses a series of boiler tube tanks the inlet and outlet ducts of which pass through the pressure vessel wall. One or several blowers serving for the circulation of the gaseous coolant through the core and over said boiler tube banks are disposed within said annular space or in communication with it and are driven via axles passing through holes in the pressure vessel wall. The construction and fixation of the blowers are described in detail. (IIB)

35731 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). French Patent 1,357,382. Feb. 24, 1964. Priority date Dec. 21, 1962, Great Britain.

A heterogeneous boiling liquid reactor comprises a chamber enclosing the reactor core, a boiling, cooling, and moderating liquid, and a vapor space above the level of the liquid. A control of this level is provided such as to oppose the pressure changes in the vapor space by changes of the reactivity provoked by this level control. Suitably the new reactor core reaches its criticality when a substantial portion of the core is above the liquid level. The portion of the chamber comprising the liquid coolant is in communication with a liquid partially occupying a pressure chamber, suitably disposed within the reactor pressure vessel and being formed by the annular interspace between said core chamber and the pressure vessel wall. Beside the level control due to a controlled injection of cold water in the vapor space of the pressure chamber, there is a self-controlling effect consisting in a level lowering provoked by a pressure increase in the core chamber and vice versa. Furthermore there is a disposition allowing the withdrawal of the whole pressure vessel out of the biological shield and the transfer of it into the storage pit. (IIB)

35732 MOBILE NUCLEAR REACTOR WITH SHIELDING SURROUNDING THE REACTOR PRESSURE VESSEL. Taylor, Anthony James (to Babcock and Wilcox Co. AG). German Patent 1,187,331. Feb. 18, 1965. Priority date Sept. 4, 1957, Great Britain.

A reactor is described in which the pressure vessel is mounted in the biological shield by means of webs and contains the graphite body or stack of the core. The core is supported from beneath by a diagrid and is surrounded by a sectioned wall comprising angle plates connected by compensating links. An outwardly extending apertured boss is formed at the center of each plate through which each plate cooperates with a tubular support extending through the biological shield. The tubular support comprises a cylinder welded at its inner end to the periphery of an aperture in the pressure vessel. A piston is arranged to slide within the cylinder. The inner end of the piston is connected to the boss of the plate by means of a ball-headed member. (Gmelin Inst.)

35733 ATOMIC REACTOR WITH FUEL PARTICLES FLUIDIZED BY MEANS OF AN ADJUSTABLE COOLANT FLOW. Dusek, Hermann; Kuttner, Paul (to Siemens-Schuckertwerke AG). German Patent 1,191,499. Apr. 22, 1965. Filed Dec. 22, 1959.

A fluidized bed reactor is described, which comprises an active portion enclosed by a vertical shell including horizontal gratings extending across the top of the shell and cone-shaped gratings across the lower portion of the shell, the lower gratings being adapted to support a bed of pellets of fissionable material. (Gmelin Inst.)

35734 ASSEMBLY COMPRISING A HEAT SOURCE AND ASSOCIATED APPARATUS. Long, Everett; Rodwell, William (to United Kingdom Atomic Energy Authority). U. S. Patent 3,185,631. May 25, 1965. Priority date Aug. 11, 1958, Great Britain.

A pressurized fluid-cooled reactor includes a reactor core, a pressure vessel containing the core, heat exchangers, and a coolant circulator to circulate coolant through the core to the heat exchangers. Coaxial ducts extend radially from the pressure vessel to the heat exchangers for transfer of the coolant. Rollers, balls, or differential roller assemblies lie in the same plane as the coaxial ducts to provide support for the pressure vessel and heat exchangers. The bearings have their axes so aligned that they permit radial thermal expansion of the pressure vessel and heat exchangers while restricting their lateral movement. This type of support arrangement and the coaxial ducting resolves some of the mechanical difficulties connected with separate ducting systems and the strains due to thermal expansion and contraction. (B.L.M.)

Fuels

Refer also to abstract 35810.

35735 (AE-187) THE NON-DESTRUCTIVE DETERMINATION OF BURNUP BY MEANS OF THE Pr-144 2.18-Mev GAMMA ACTIVITY. Forsyth, R. S.; Blackad-

der, W. H. (Aktiebolaget Atomenergi, Stockholm (Sweden)). May 1965. 22p. Dep.(mn).

Experiments carried out to calibrate a gamma scanner for quantitative measurements by counting the 2.18 Mev gamma activity due to ^{144}Pr, the short-lived daughter of ^{144}Ce (t $\frac{1}{2}$ 285 days) from selected pellets in several UO_2 fuel specimens, are described. Accurate burn-up values were then determined by dissolution and application of the isotopic dilution method using stable molybdenum fission products. The elements, which were rotated about their longitudinal axes to minimize assymetry effects, were viewed by a sodium iodide crystal and a multichannel analyzer through a suitable collimator. Correction for attenuation of the gamma activity (much less than for 0.75 Mev) in the fuel elements which were of different diameters (12.6 to 15.04 mms) was made by applying relative attenuation factors, and the effective geometry factor of the instrument was determined. In order to check the corrections applied, the counter factor was also calculated for the 0.75 Mev activity from $^{95}Zr/^{95}Nb$, and in certain cases for the 0.66 Mev activity from ^{137}Cs. The results obtained demonstrate that, at least over the range of diameters and cooling times used, the method is suitable for quantitative determinations. Preliminary experiments to explore the possibility of using the high energy gammas (2.35, 2.65 Mev) from ^{106}Rh as a method for estimating the fraction of fission events which have taken place in the ^{239}Pu formed during irradiation were also carried out. Determination of the relative intensities of the gammas suggest that the method is only of limited application. (P.C.H.)

35736 (CEA-R-2795(Vol.I) ETUDE DES VALEURS ET DES PRIX DU PLUTONIUM A LONG TERME — UN MODELE PARAMETRE SIMPLIFIE. VOLUME I. EXPOSE GENERAL DE L'ETUDE. (Study of the Long-Term Values and Prices of Plutonium — A Simplified Parametrized Model. Volume I. General Description of the Study). Gaussens, Jacques; Paillot, Henri (Commissariat a l'Energie Atomique, Paris (France)). May 1965. 56p. (In French and English) Dep.(mn).

A definition is given of the notions of use values and price of plutonium. A "simplified parametrized model" is given simulating the equilibrium of the offer and the demand in time, concerning the plutonium and the price deriving from the relative scarcity of this metal, taking into account the technical and economic operating parameters of the various reactors confronted. This model is simple enough to allow direct computations and establish clear relations between the various parameters. The use of the linear programs method allows on the other hand a wide extension of the model. (auth)

35737 FUEL ELEMENTS. Power Reactor Technol., 8: No. 2, 126-32(Spring 1965).

Studies on fabrication, properties, and testing of UO_2 cermet fuels for fast reactors are reviewed. Work on fabrication and inspection of various fuel assemblies is discussed. 17 references. (M.J.T.)

35738 OXIDE FUELS FOR FAST REACTORS. Zebroski, Edwin L. (General Electric Co., San Jose, Calif.); Mustelier, J. P.; Caldwell, C. p.110-25 of ANS-100.

Properties and test results on mixed U–Pu oxide fuels for fast reactors are summarized under the categories: fuel properties; plutonium and fission products; diffusion effects; sodium-fuel reactions; fuel irradiation effects; and cladding behavior. Results include in-pile and out-of-pile conductivity measurements on 20% Pu 80% oxide; and the effect of stoichiometry on melting point, conductivity, and other properties. Plutonium diffusion rates have been measured. Segregation of fission products under various thermal conditions has been observed and there is preliminary evidence for limited migration of plutonium under some conditions. The resistance of UO_2 and mixed oxide fuels to short-term damage by sodium logging has been tested, and further observations made on the occurrence of a sodium-fuel reaction zone in low temperature regions. Encouraging results have been obtained on the feasibility of vented fuel. Observations on the axial and radial redistribution of oxide fuel by vapor transport, creep, and by molten fuel slumping are summarized. Preliminary observations on the swelling of mixed oxide fuels at high burnups are evaluated. Further observations have been made on the effects of operation with molten fuel in respect to cladding deformation in steady-state and in transient irradiations. Other fuel-cladding interactions are briefly surveyed. (auth)

35739 METALLIC FUEL ELEMENTS FOR FAST REACTORS. Kittel, J. H. (Argonne National Lab., Ill.); Sebilleau, F.; Rateick, R. G. p.157-69 of ANS-100.

Metallic fuels have been used in almost every fast reactor constructed to date because of their advanced fabrication technology, their high fissile and fertile atom density, and their high thermal conductivity and thermal expansion. Their continued use in future fast reactors, where more severe conditions of temperature and burnup will exist, depend almost entirely upon developing a satisfactory solution to the problem of fuel swelling. Of the various approaches to the fuel swelling problem, the following have greatest promise: use of finely-divided second-phase particles to induce a homogeneous nucleation of fission gas bubbles; use of a strong jacket or can combined with suitably located void space to permit a controlled amount of fuel swelling within the jacket; and use of fuel alloys with higher melting points than those available. Progress has been made through use of strong jackets, which have enabled burnups greater than 5 at. % to be achieved in uranium–plutonium alloys with fuel surface temperatures of 550°C. Other experimental fuel elements under irradiation have been designed to achieve various burnups in the range of 6 to 15 at. %. (auth)

35740 FUEL ELEMENT FOR A NUCLEAR REACTOR. Hildebrand, Gosta Erik (to Fulcrum AG). British Patent 989,889. Apr. 22, 1965. Filed Mar. 9, 1962.

The reactor fuel element patented consists of a central core of fissile material of high thermal stability, an outer mantle of fissile material, and an intermediate layer of nonfissile material for transferring heat from the core to the mantle. Suitable materials for each part and methods of fabrications are proposed. (A.G.W.)

35741 IMPROVEMENTS IN OR RELATING TO HEAT-TRANSFER DEVICES. Le Foll, Jean; Peice, Jacques (Commissariat a l'Energie Atomique). British Patent 990,414. Apr. 28, 1965. Priority date May 27, 1960, France.

A method for minimizing local reductions in heat-transfer coefficients is applicable to devices consisting of a cylindrical heat exchange surface equipped with fins defining helices about the axis of the surface and with primary longitudinal partitions distributed over the surface to form helical circulation ducts interrupted by the partitions. Additional longitudinal partitions shorter than and distributed between the primary longitudinal partitions are provided only in the region in which it is desired to increase the heat-transfer coefficient. (A.G.W.)

35742 NUCLEAR REACTOR FUEL ELEMENTS. Thorn, James Douglas; Challender, Ronald Scott (to United Kingdom Atomic Energy Authority). British Patent 991,258. May 5, 1965. Filed June 4, 1962.

Fuel elements sheathed in a moderating material such as graphite are arranged in parallel to form a cluster. The fuel elements are supported in contact with one another, except at interspaces for coolant flow, by two end support members and interbraced by at least one intermediate grid member. The sheath of each fuel element consists of at least two portions extending along a common longitudinal axis and having adjacent ends sealed into the grid member. The end support members are secured in tied relationship by one or some of the fuel elements. The remaining fuel elements are axially unrestrained to accommodate expansion. Access for a lifting grab for the cluster is provided. (A.G.W.)

35743 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGER ARRANGEMENTS AND FUEL ELEMENT

SHEATHS INCORPORATING SAME. Mailliet, Ennemond; Pelce, Jacques (to Commissariat a l'Energie Atomique). British Patent 996,211. June 23, 1965. Priority date Mar. 16, 1961, France.

A heat exchanger arrangement is provided that is particularly applicable to fuel element sheaths in which several series of parallel fins project normally from a wall in contact with a cooling fluid. The fins of one series are oriented oppositely with respect to those of a neighboring series so that the fins of adjacent series together form a chevron type pattern and define elementary channels of substantially constant width. The fins are curved at the upstream and/or downstream ends in such a manner that the fluid stream is progressively deviated from the general direction of flow at the inlet to each channel and is progressively directed towards the outlet. The fins are thinner in that part remote from the wall than at that part adjacent to the wall. (B.L.M.)

35744 A DEFINITE NUCLEAR FUEL ELEMENT FOR BOILING REACTORS WITH NEUTRON-MODERATING COOLANT. Imhoff, Donald Hay (to General Electric Co.). German Patent 1,187,744. Feb. 25, 1965. Priority date Nov. 4, 1958, United States.

A fuel element is described in which the total fissile and fertile atom content per unit length decreases and in which the fissile atom content per unit length is substantially uniform along the length of the fuel element. An elongated fuel element is formed by a plurality of axially aligned fuel pellets, the fuel pellets being either solid or hollow. (Gmelin Inst.)

35745 NUCLEAR FUEL PIN END CLOSURE. Flora, Herbert E.; Shield, George K. (to Babcock and Wilcox Co.). U. S. Patent 3,180,804. Apr. 27, 1965. Filed Oct. 3, 1961.

A fuel pin consisting of an elongated tube containing fissionable material is closed by inserting, closed end first, a circular cup-shaped tapered member so that its outer surface is coextensive with the inner surface of the end of the tube. A welding groove is provided at the juncture of the end of the tube and the outer end of the cup-shaped member, in which a weld may be made with an automatic welding machine. (A.G.W.)

35746 FUEL ELEMENTS FOR NUCLEAR REACTORS. Bradley, Norman (to United Kingdom Atomic Energy Authority). U. S. Patent 3,185,632. May 25, 1965. Priority date June 29, 1959, Great Britain.

A reactor fuel assembly includes a tubular coolant conducting housing, a cluster of elongate fuel elements disposed in parallel array longitudinally within the housing. A support structure is made up of end supports for the fuel elements and at least one grid form support spaced between the end supports. The entire support structure serves to hold the fuel elements in spaced relation to each other and to form passages for coolant flow along the fuel members. Each fuel element is made up of a column of fuel material enclosed by a tubular sheath. A plug of heat-insulating non-fissile material divides the column into end-spaced sections, and the plug is disposed in the plane of the spacing structure. (B.L.M.)

Power and Power-Breeder Reactors

Refer also to abstracts 34100, 34328, 34399, 34629, and 35738.

35747 (ACNP-63601) LARGE FAST-REACTOR DESIGN STUDY. Monthly Report, September 1963. (Allis-Chalmers Mfg. Co., Milwaukee, Wis. Atomic Energy Div.; Atomic Power Development Associates, Inc., Detroit, Mich.; and Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). Contract AT(11-1)-1316. 10p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Based on a review of physics studies, it was concluded that no single design parameter can be varied sufficiently to achieve a negative sodium coefficient and still achieve a practical core design. A reference core 9 ft ID × 13 ft OD × 4 ft high with a 6-in. lower axial blanket, an 18-in. upper axial sodium reflector and 18-in. thick inner and outer radial blankets was therefore selected. Refined calculations of the sodium coefficient in the large oxide core were started. The hexagonal array fuel assembly design is being modified to provide venturi-type hydraulic hold-down. An estimate of the number of fuel-blanket control assemblies and fuel-poison safety assemblies was made to permit vessel and core support layout work to proceed. A rotating plug refueling system was conceived. (M.C.G.)

35748 (ACNP-63602) LARGE FAST-REACTOR DESIGN STUDY. Monthly Report, October 1963. (Allis-Chalmers Mfg. Co., Milwaukee, Wis. Atomic Energy Div.; Atomic Power Development Associates, Inc., Detroit, Mich.; and Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). Contract AT(11-1)-1316. 7p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

The reference core was changed so that the upper 6 in. of the sodium reflector on the fuel assemblies was replaced by boron carbide-containing pins. This will prevent backscattering of neutrons during sodium voiding of the reflector design and thus enhance the effect on the sodium coefficient. Effective values for the coarse group elastic removal and transport cross sections for the light elements at various sodium concentrations were calculated. A code was written to compute the change in plutonium isotopic composition with burnup and recycling. A value of +0.01 was calculated for loss of core sodium. Calculations were also made on a 5000 liter cylindrical core power flattened by four enrichment zones. Studies of the bowing of a fuel rod and a fuel assembly were initiated. The reactor vessel elevation and plan view drawings were approximately 90% complete. (M.C.G.)

35749 (AGN-TM-410) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. ML-1 THERMODYNAMIC PERFORMANCE TEST (ANSOP 16650). Final Test Report. (Aerojet-General Nucleonics, San Ramon, Calif.). May 1965. Contract AT(10-1)-880. 205p. Dep.(mn); $6.00(cy), 4(mn) CFSTI.

The results of analyses of data developed during operation of the ML-1 nuclear power plant under ANSOP 16650, "ML-1 Thermodynamic Performance Test" are discussed. The reactor operated for 4064 Mwh at a power level in excess of 2.0 Mw, and 1876.6 hr of turbine-compressor set rotation were accumulated, including 1774.7 hr at self-sustained conditions. All major test objectives were achieved. The test operation demonstrated the improved long-term reliability of the ML-1 power plant. The analysis of test data confirmed that the primary plant performance deficiency, however, is associated with the turbine-compressor set. The maximum t-c set shaft output power measured during this test was 101 kw. The mechanical and neutronic performance of the reactor were essentially as predicted. The analyses of the effectiveness of the reactor shielding indicated that this critical part of the plant performed as designed. The performance of other components was generally acceptable and similar to that experienced in earlier testing. (auth)

35750 (APDA-169) TOPICAL REPORT ON THE EVALUATION OF EOCR AS A FAST FUEL TEST FACILITY. Huebotter, P. R. (and others) (Atomic Power Development Associates, Inc., Detroit, Mich.). June 25, 1965. Contract AT(11-1)-865. 59p. Dep.(mn); $3.00 (cy), 2(mn) CFSTI.

The technical merits of using the Experimental Organic Cooled Reactor (EOCR) as a fast reactor fuel test facility are discussed. Design and performance criteria for two types of loops, whose incorporation into the EOCR core is practical, were established on the basis of near-term fast reactor fuel testing needs. The ability of the EOCR to produce, using high-energy neutrons, rates of plutonium fissioning and fuel element cladding damage of interest to

the designers of large (1000 Mw(e)) fast reactor power plants was evaluated. Part of the evaluation consisted of planning a four-year program of fuel testing that would use five loops in the EOCR appropriately modified to permit operation at twice the power density originally planned—that factor of improvement having been established as requisite for meaningful testing of advanced fuel reactor fuel pins. This radiation program attempts to utilize the unique capabilities of the EOCR for fast reactor fuel testing and to illustrate the role this facility could play in the USAEC's efforts to develop economical fuel systems for large fast reactor power plants. (auth)

35751 (BAW-393-1) THORIUM FUEL CYCLE FOR HEAVY WATER MODERATED ORGANIC COOLED REACTORS. Quarterly Technical Report No. 1, January–March 1965. (Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). Contract AT(38-1)-393. 75p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

Work during the period January 1 to March 31, 1965, on the Thorium Fuel Cycle Development Program, which is part of the Atomic Energy Commission's overall Heavy Water Moderated Organic Cooled Reactor Program is described. The three objectives of the thorium program are as follows: development of technology necessary to optimize the design of heavy water moderated organic cooled reactors (HWOCR) capable of operating on a thorium fuel cycle having potential for breeding, determination of the relative economics of operating an HWOCR, optimized for the uranium fuel cycle, on a thorium fuel cycle, and determination of the sensitivity (and the degree of precision thereof) of various pertinent HWOCR parameters on doubling time and breeding ratio and economics. Work was started on all nine tasks of the program. (auth)

35752 (BNWL-52) EXPONENTIAL EXPERIMENTS AND NEUTRON MULTIPLICATION MEASUREMENTS WITH 1.25 WT PERCENT ENRICHED N-REACTOR FUEL ELEMENTS IN LIGHT WATER. Brown, C. L.; Lloyd, R. C.; Bierman, S. R.; Clayton, E. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1965. Contract AT(45-1)-1830. 12p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Subcritical experiments were performed with N-Reactor spike enriched fuel elements in light water to provide data for nuclear safety guidance. Exponential and neutron multiplication measurements were performed on 1.25 wt % enriched outer tubes (2.41 in. OD, 1.76 in. ID) and on tube-in-tube assemblies comprised of the outer tube and an 0.95 wt % enriched inner tube (1.25 in. OD, 0.44 in. ID) in each of four lattice pitches. Maximum bucklings were found to be 4680 microbucks for the outer tubes and 3900 microbucks for the tube-in-tube assemblies. Figures showing material buckling, critical mass, volume, slab thickness, and cylinder diameter as a function of water to fuel volume ratio are presented. Safe values for nuclear safety guidance are also presented. Pulsed neutron source measurements on two of the 1.25 wt % enriched outer tube lattices indicate the difference between delayed criticality and prompt criticality to be about five fuel columns for these lattices. (auth)

35753 (COO-652-14) PIQUA NUCLEAR POWER FACILITY MONTHLY OPERATING REPORT NO. 24. (Piqua Nuclear Power Facility, Ohio). Apr. 1965. Contract AT(11-1)-652. 29p. Dep.(mn); $2.00(cy), 1(mn) CFSTI

The reactor was operated 138 hr during the month, with all of the operating time being associated with testing activities. The reactor was shutdown on April 2 as a result of control rod drive unit failures. Power operation was reinitiated on April 27, and the power was held at 16 Mw(t) through the rest of the month. The neutron source range detector cans continued to pick up moisture. While the reactor was down, all of the pressure trip units were checked. Coolant drained from the reactor at the time of shutdown was collected and purified. Reactivity checks were calculated using a base point of 3.4 Mw with the core at operating temperature. An analog computer was obtained and is operating as a xenon and samarium calculator. Plant performance and health physics data are presented in tables and graphs. (M.C.G.)

35754 (EURAEC–1379) HYDRODYNAMIC INSTABILITY LIMITING THE POWER OF BOILING WATER REACTORS. Quarterly Report No. 4, October 1–December 31, 1964. Boure, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Mar. 5, 1965. Contract 006-64-1 TEEF. 46p. (EUR–2340) Dep.(mn); $2.00(cy), 1(mn) CFSTI

Work Performed under United States-Euratom Joint Research and Development Program.

The numerical study of the equations obtained with the "density effect" model is discussed. Physical meanings of the parameters appearing in these equations are summarized. The main features of the numerical study and their relation with the experimental study are given. Detailed results are given for five cases and a brief discussion shows that the agreement between the model and the experimental results is good. (auth)

35755 (GA-5559) INVESTIGATION OF TURBOCIRCULATOR FOR TARGET, A 1000-Mw(e) REACTOR. Summary Report. Yampolsky, J.; Barbat, V.; Berman, H.; Cavallaro, L.; Ross, F.; Todt, L. (General Atomic, San Diego, Calif.). Sept. 28, 1964. Contract AT(04-3)-167. 130p. Dep.; $4.00(cy), 3(mn) CFSTI.

The present study was undertaken for the purpose of determining the feasibility, establishing the required development program, and estimating the cost of a turbocirculator to provide the pumping power for a 1000-Mw(e) High-temperature Gas-cooled Reactor (HTGR) power plant as part of the TARGET program. This necessitated preliminary design of the turbocirculator in conjunction with the reactor power plant as well as the investigation of methods for the optimization of the turbocirculator and for its development. The study was carried out in sufficient detail to fix the methods required to resolve the problems that would be encountered during the course of a prototype program resulting in a turbocirculator for the TARGET power plant. Methods were developed such that for a given set of reactor conditions, the design point optimization of the turbocirculator components was accomplished. This involved, first, optimization of the thermodynamic cycle and, second, design optimization of the compressor and turbine components. The mechanical design and installation within the primary containment vessel in the TARGET reactor plant were investigated, and a preliminary design was established for the turbocirculator and its required accessory system. In addition, an investigation of the stability and control problems of the machine was initiated. The final goal of a prototype turbocirculator imposed the requirement for a development program, which included the preliminary design and cost estimate for a test facility for the full-scale test and development of the machine. (auth)

35756 (GEAP-3863) CONVERSION RATIO MEASUREMENT IN URANIUM-FUELED, LIGHT-WATER-MODERATED, SUPERHEATER LATTICES. Antunez, H. M. (General Electric Co., San Jose, Calif. Vallecitos Atomic Lab.). Mar. 1, 1962. Contract AT(04-3)-189. 31p. Dep. (mn); CFSTI, $2.00 (cy), $0.50(mn).

The conversion ratio was measured in uranium-fueled, light-water-moderated, superheater lattices. A new method applicable also to other types of reactors was developed for use in the measurement. To make sure that the fuel samples used were representative of the fuel, full-size pellets of the irradiated fuel were dissolved and gamma counted. Neither geometrical imperfections nor neutron spectrum alterations affect the measurement. The method also has these advantages: (a) chemical separations are not required, (b) irradiation under cadmium is not required, and (c) irradiations amounting to less than 10^{12} n/cm^2 are enough. Special care was taken to prevent the occurrence of systematic errors, for which there are several possible sources in similar methods. The precision was improved up to ±0.6% (70% confidence intervals). The basic idea of the method is that two separate gamma-counting channels are defined so that the corrected count rate in the first channel is proportional to the number of Pu atoms produced in an ordinary fuel pellet, and that the corrected count rate in the second channel is pro-

portional to the number of fissions which occurred in the same fuel pellet. The relative counting efficiencies of the two channels are normalized by irradiating samples of uranium of different enrichments in a thermal flux. (auth)

35757 (GEAP-4810) EVESR-NUCLEAR SUPERHEAT FUEL DEVELOPMENT PROJECT. Eleventh Quarterly Report, December 1964–February 1965. Murray, J. L. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar. 1965. Contract AT(04-3)-189. 188p. Dep.(mn); $5.00(cy), 4(mn) CFSTI.

The reactor remained shut down during the first portion of the reporting period to complete interconnection of the P G and E turbine-generator, loading of four Mark III advanced fuel bundles and two specially instrumented Mark II fuel bundles, and other plant modifications. Critical tests were performed for the new core loading at zero power and at various power levels in the planned startup program to evaluate performance, the turbine-generator, and the system changes that were made for operation at 17 Mw(t). All systems performed well. Failure of a tube in the gas-fired boiler necessitated a 10-day shutdown, and a temporary steam flow limit which prevented operation above 12.5 Mw(t) during the quarter. Twenty ppm O_2 and 2.5 ppm H_2 in the EVESR saturated steam supply was maintained since startup with the Mark III fuel inserted. The gas injection system now performs satisfactorily for both manual and automatic control. Radioactivity release from the EVESR fuel continues at a very low level. A blockage of steam flow occurred in the clad thermocouple fuel bundle resulting in peak cladding temperatures which may have been as high as 2200°F. Subsequent sustained operation of the reactor at 12.5 Mw(t) revealed no adverse effect of the incident on the fuel cladding integrity. The isothermal corrosion test facility was installed and placed into operation with the first loading of corrosion coupons. The DARE code was used to prepare a summary of the conditions and significant aspects of the period of operation with the all-Mark II core. The enrichment study was completed for the Advanced BONUS Core prototype irradiation in EVESR. An enrichment of 15% ^{235}U in the ABC elements satisfied all the physics and thermal-hydraulic requirements. Preliminary mechanical design of the test bundle was completed as part of the enrichment study. (auth)

35758 (GEAP-4899) FINAL SAFEGUARDS REPORT FOR GARIGLIANO DEVELOPMENT PROGRAM. Howard, C. L.; Santasilia, F.; Viscuso, S.; Colling, A.; Youngborg, L. H.; Sorlie, T.; Collett, W. I.; Duckart, A. C.; Holland, L. K.; Barth, N. H. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). June 1, 1965. Contract AT(04-3)-189. 166p. (EURAEC-1411). Dep.(mn); $5.00(cy), 3(mn) CFSTI.

Work Performed under United States–Euratom Joint Research and Development program.

The Garigliano Development Program is described, the reactor tests to be performed as part of the program are outlined and the calculations which were made to determine that the proposed tests are safe are presented. The objectives of the tests are to measure the reactor performance at conditions which simulate operation of the reactor at thermal powers 1.5 to 2 times greater than the present rating and compare measured and calculated reactor performance and stability at various test conditions. As a guide to the future preparation of detailed test procedures, pretest calculations of reactor stability and critical heat flux were made for a variety of reactor flow rates and power levels. In order to accomplish the test objectives several temporary changes in the plant technical specifications are requested. These changes are listed. The effects of these specification changes are discussed, and it is concluded that these revised limits are adequate to provide assurance of reactor safety during the proposed tests. Parts of the technical specifications not listed in this report are unchanged and are applicable during the tests. At the conclusion of the Garigliano Development Program tests, these temporary specification changes will be terminated and the normal limits will again apply. (M.O.W.)

35759 (HW-84384(p.10.1-13)) PLUTONIUM RECYCLE TEST REACTOR OPERATION AND RELATED FUNCTIONS. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Activities associated with the PRTR are reported concerning operation, design and testing, fuel element rupture testing, core design, fuel reuse, shim control development, fretting corrosion, reactor decontamination, moderator chemical shim development, and shutdown radiation measurements. Other work is reported on Al alloys development and corrosion, fluid flow at high pressures and temperatures, boiling burnout, and heat transfer in heavy water reactors. (J.R.D.)

35760 (IEA-85) CALCULATION OF THE NEUTRON FLUX DISTRIBUTION IN THE EBWR CORE SHIELDED BY WATER, IRON, AND CONCRETE. Hehl, Wilma Sonia (Instituto de Energia Atomica, Sao Paulo (Brazil)). Dec. 1964. 25p. Dep.(mn).

The operation of the EBWR at 100 Mw when shielded by 28.6 cm of water, 10 cm of iron and 300 cm of concrete was considered. The equal-volume sphere core, with a radius of 73 cm was chosen for the study as indicated by calculations for the best core geometry. The fast and thermal neutron flux calculations were done by two-group analysis. Calculations for the latter were made both by hand and by computer. The procedures followed and the calculations made in connection with the study are explained, and the results are tabulated and plotted. (auth)

35761 (LA-3194) CONTROL ROD CALCULATION TECHNIQUES WITH APPLICATIONS TO THE UHTREX REACTOR. Carmichael, B. M.; LaBauve, R. J. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Nov. 1, 1964. Contract W-7405-eng-36. 90p. Dep.(mn); $4.00(cy), 2(mn) CFSTI.

Two-group, multiregion, analytic calculations of control ring worths in UHTREX are compared with results from two-dimensional, diffusion theory (CRAM code), and two-dimensional, S_n, transport theory (DDK code). (auth)

35762 (NAA-SR-10006) DEVELOPMENT OF SPECIAL VIEWING AND PHOTOGRAPHIC EQUIPMENT FOR THE SRE REACTOR CORE. Meise, E. R. (Atomics International, Canoga Park, Calif.). June 15, 1965. Contract AT(11-1)-Gen-8. 26p. Dep.(mn); $2.00(cy), 1(mn) CFSTI

The SRE is operated as a development and experimental facility. Between power runs and during some experimental programs it becomes necessary to view and photograph the interior of the SRE reactor core. A viewing device and special attachments that were designed and fabricated at the SRE site for core viewing and photography are described. Design objectives, design principles, pictures of the equipment, and pictures of the core interior are included. (auth)

35763 (NAA-SR-10743) HALLAM NUCLEAR POWER FACILITY REACTOR OPERATIONS ANALYSIS PROGRAM. Semiannual Progress Report No. 4, February 29, 1964–September 30, 1964. Berger, S.; Darley, D. K.; DeBear, W. S. (and others) (Atomics International, Canoga Park, Calif.). May 15, 1965. Contract AT(11-1)-Gen-8. 159p. Dep.(mn); $5.00(cy), 3(mn) CFSTI.

From March 1, 1964, through September 30, 1964, the HNPF was in operation 2,748.7 hr, generating 72,547,000 kwh of electrical energy for an accumulated total of 192,460,000 kwh. Operations are reviewed. Data are presented in tables and graphs on reactivity history, fuel element exposure, moderator element failures, control rods, in-core temperatures, fuel channel variable orifices, reactor scram analysis, shutdown margin, special studies related to HNPF moderator elements, systems and components analysis, and the component reliability program. (M.C.G.)

35764 (NAA-SR-11142) PIQUA NUCLEAR POWER FACILITY REACTOR OPERATIONS ANALYSIS PROGRAM. Semiannual Progress Report No. 5, July 1–December 31, 1964. (Atomics International, Canoga Park, Calif.).

June 15, 1965. Contract AT-11-1-GEN-8. 115p. Dep. (mn); $4.00(cy), 2(mn) CFSTI

Refueling of the Piqua Reactor was completed the first week in July, and checkout of the control rods was completed satisfactorily. The reactor was operated for a short time at zero power to determine the new critical position, shutdown margin, and control rod worths. The reactor was made critical on August 10 and power operation resumed on August 11. Plant availability for August was 88.3% and for September was 100%. The reactor was shut down October 7 to 15 for repair of a superheater tube leak. Operation was continuous in November. The reactor was shut down on December 7 when the in-vessel filter ΔP reached the technical specification limit of 10 psi. On December 25, the filter ΔP again approached the limit, and one pump was shut down to reduce flow and thereby decrease the filter pressure drop. With only one main pump operating, reactor power was limited to 27.3 Mw(t). Data are presented in tables and graphs on nuclear analyses, systems and components analyses, examinations of in-core filters coolant chemistry, and effects of oxygen on irradiated Piqua coolant. (M.C.G.)

35765 (NAA-SR-Memo-10167) PERMISSIBLE HYDROGEN LEVELS IN THE HNPF CONTROL ROD HELIUM SYSTEM. Perret, J. D. (Atomics International, Canoga Park, Calif.). Nov. 18, 1964. Contract AT-11-1-GEN-8. 26p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Based on conservative assumptions, a 150 ppM maximum level for hydrogen in Zircaloy, and a required 10 year service life, it is calculated that the maximum permissible level of hydrogen in the control rod thimble gases is 700 ppM by volume. Neither experimental results nor a theoretical treatment of the diffusion of one species of a mixture of gases through a metal container wall could be found in the literature. Standard catalytic adsorption theory was combined with the usual diffusion theory to derive equations useful for the calculations of interest. This approach may have utility in similar problems. (auth)

35766 (NAA-SR-Memo-11041) LSGR FAST SHUTDOWN PROCEDURE. Halfen, F. J. (Atomics International, Canoga Park, Calif.). Feb. 12, 1965. Contract AT-11-1-GEN-8. 45p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Several additional shutdown procedures were analyzed for possible use on the 200 Mw(e) SGR. These schemes are: sequenced rod drop; rod rundown and pump shutdown delay; scram and pump shutdown lead; and rod drop and rundown of rods. All of these schemes assume that the pumps are shutdown some time prior to, during, or shortly after control rod insertion. The best scheme (referred to as a "fast shutdown" procedure) for minimizing coolant exit temperature transients found thus far is the sequenced rod drop scheme. The procedure currently considered best involves simultaneous pump trip and gravity insertion of one control rod followed by gravity insertion of two rods five seconds later and the remaining rods 15 seconds after the initiation of the sequence. This procedure limits the fuel element coolant exit temperature variation to less than 82°F for normal "fast shutdown," fast shutdown following a rod withdrawal accident, and fast shutdown following a loss of flow accident. A significant improvement in the post-shutdown temperature transient over that obtained with the previously reported procedure is shown to be obtainable. (auth)

35767 (NAA-SR-Memo-11046) HNPF ALTERNATE CORE MODIFICATION STUDIES. Aronstein, R. E.; Campise, A. V.; Speigler, P.; Vitti, J.; Pearson, E.; Casey, D.; Holz, H. B.; Keim, M.; Gibson, A. S. (comp.) (Atomics International, Canoga Park, Calif.). Feb. 18, 1965. Contract AT-11-1-GEN-8. 23p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The feasibility of modifying the existing Hallam Nuclear Power Facility to accommodate various advanced types of cores is considered. Two general types of cores were considered, one being an advanced thermal reactor and the other being the prototype of a fast reactor. The thermal reactor design utilizes an auxiliary calandria vessel inside the existing reactor vessel. This auxiliary calandria vessel is designed to support the reactor fuel elements in process tubes and to house graphite moderator inside of the calandria structure. Two versions of a fast reactor design were studied, one version being a multi-region modular array of two fuel enrichments and moderator. This fuel and moderator are arranged to produce optimum safety characteristics without significantly softening the neutron spectrum in the fast region of the module. The second version of the fast reactor is a beryllium oxide moderated (BOM) fast reactor core which has a slight softening of the neutron spectrum thereby achieving an improved Doppler coefficient. Some of the important characteristics of the various concepts studied are tabulated. A basic objective was to determine the feasibility of inserting any of the advanced core designs in the Hallam facility with a minimum of modifications to the facility. It was also an objective that a maximum of significant parameters be prototypic of a large reactor facility. In addition, in the case of the fast reactor evaluation, the safety characteristics of the core designs were to be sufficiently conservative and well enough understood to permit installation of the new cores without extensive redesign or modification of the existing containment. The results of these studies are described. (auth)

35768 (ORNL-3209) A COMPARISON OF GAS-TURBINE AND STEAM-TURBINE POWER PLANTS FOR USE WITH ALL-CERAMIC GAS-COOLED REACTORS. Fraas, A. P.; Ozisik, M. N. (Oak Ridge National Lab., Tenn.). July 1965. Contract W-7495-eng-26. 82p. Dep.(mn); CFSTI, $3.00(cy), $0.75(mn).

The reactor outlet gas temperatures obtainable with metal encapsulated fuel have been too low to give an attractive gas-turbine installation, but with ceramic fuel elements the reactor outlet gas temperature could be as high as the permissible inlet temperature to any foreseeable gas turbine. Gas turbines are compared with steam turbines as a means of producing electric power from gas-cooled reactors with all-ceramic fuel elements. The first portion of the study was a parametric investigation of gas-turbine power plants to investigate the effects of regeneration, pressure losses in components, system pressure level, and system operating temperatures. Earlier work on gas-cooled reactors was then utilized to select a good set of reactor core proportions, with due allowances for heat transfer and stress limitations, fuel-cycle costs, and reactor, pressure vessel, and shielding costs. Based on these proportions and data from the parametric survey, a series of eight power plant configurations was investigated and compared from the standpoint of costs, hazards problems, and maintenance. The best of these configurations was then chosen, and a conceptual design of a gas-turbine plant was prepared. The features, problems, and costs of this plant were then compared with those of a comparable steam-turbine plant. The study indicates that a steam-turbine plant gives a higher thermal efficiency, lower initial capital charges, and substantially less-difficult maintenance problems than the gas-turbine plant. The heat exchanger equipment and duct work are much larger and the gas system is more complex in the gas-turbine plant. The lower thermal efficiency increases both the reactor size and the fuel-cycle costs. Perhaps the most important factor is that the turbine and compressor rotors in a gas-turbine plant are very large, heavy, and cumbersome. Since they would also pick up about 100 times as much activity as the rotors in the gas-circulating blowers for a steam plant, they would pose vastly more difficult maintenance problems. (auth)

35769 (ORNL-3642) GAS-COOLED FAST REACTOR CONCEPTS. (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 235p. Dep.; $3.00 (CFSTI)

The performance characteristics of gas-cooled fast reactors compare well with those of sodium-cooled fast reactors. With oxide fuel and helium, CO_2, and SO_2 coolant at pressures of 1000 to 1500 psia, these reactors have slightly

higher breeding ratios than comparable sodium-cooled reactors. Reference designs are presented for two concepts of a fast reactor with a net electrical output of 1000 Mw. One design is for a helium-cooled indirect-cycle system and the other is for a supercritical SO_2-cooled system. The power cycle for the helium-cooled reactor is a conventional steam cycle, but the SO_2 is used in a direct Rankine cycle to generate power in a turbine at an overall thermal efficiency of 32% and at a lower cost. (auth)

35770 (ORNL-3812) MOLTEN-SALT REACTOR PROGRAM SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING FEBRUARY 28, 1965. (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 185p. Dep.; $5.00(cy), 3(mn) CFSTI.

Activities in the MSRE program are summarized in sections on operations, component development, reactor analysis, metallurgy, radiation chemistry, chemistry, and fuel processing. Separate abstracts were prepared for each section. (J.R.D.)

For abstracts of individual sections see: 34100, 34629, 34749, 35771, 35772, 35773, and 35774.

35771 (ORNL-3812(p.5-26)) MSRE OPERATIONS. (Oak Ridge National Lab., Tenn.).

In plant operation the principal activities included leak testing, purging, and heating the salt systems, charging salt, completing startup checklists, and operating with salt circulating in the fuel and coolant loops. Among the more important experiments conducted during the prenuclear operation were the determination of entrained gas volume in the fuel loop and the measurement of time constants associated with removal of a noble gas from the salt and graphite. Design, procurement, fabrication, installation, and check-out of the MSRE instrumentation and controls systems are now essentially complete. Components for the fuel sampling and enriching system and the coolant salt sampling system were completed. Fabrication of tanks for the vapor-condensing system was started, and the water tank was completed. The gas tank was nearly completed. The fuel and coolant pumps were installed in the piping systems. After undergoing modification to eliminate tube vibration, the heat exchanger was installed. The installation of all component and pipe heaters, thermal insulation, and heater power circuits was completed, and the systems were checked. The high-bay containment was completed. All components, heaters, thermal insulation, and electrical circuits were installed in the drain tank cell. The charcoal beds and the vent house piping installations were completed. The control rod drives were installed and checked. The coolant sampling system was installed and the fuel sampling and enriching system installation was nearly completed. Installation of the vapor-condensing system was started. Excavation work was completed, and the water tank was delivered to the site. (J.R.D.)

35772 (ORNL-3812(p.27-53)) COMPONENT DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Prototypes of the removable heater for 5-in. pipe and the drain tank heater completed over 8000 hr of satisfactory test operation. The drain tank cooler test was shut down due to failure of one of the ½-in. water tubes after a total of 2551 thermal cycles from 1200 to 200°F. Testing is continuing to determine the life of other parts of the cooler assembly. The five freeze flanges in the 5-in. pipe in the MSRE were assembled. The freeze valves in the drain tank cell, coolant cell, and reactor cell were tested as part of the prenuclear operation of the reactor. Fabrication and run-in of the control rods were completed, and the rods were shipped to the reactor. The prototype control rod drive completed 124,400 cycles of 102-in. travel per cycle in 150°F ambient temperature. Temporary samplers were designed and installed on the fuel drain tank and fuel pump bowl for use during the prepower operations. The Engineering Test Loop was shut down after 15,400 hr of trouble-free operation. The program to demonstrate remote maintenance tools and techniques was continued in conjunction with the installation of the reactor components Design, development, and testing of a high-temperature transformer for use with a float-type molten-salt level transmitter on the Mark II fuel circulating pump were completed. Installation of four conductivity-type single-point level indicator probes in MSRE drain tanks was completed. The bubbler-type molten-salt level indicators installed in the MSRE performed satisfactorily during startup and precritical operation of the MSRE systems. Performance of MSRE prototype thermocouples installed on the engineering and prototype pump test loops continues to be satisfactory. Radiation damage testing of a typical extension cable, disconnect, and thermocouple assembly was terminated after eight months exposure to a ^{60}Co gamma source; the resistivity of the insulation remained high. Installation of the MSRE temperature scanner systems was completed, and the systems were used during initial heat-up of MSRE piping and components and during subsequent operations. A stable, adjustable millivolt reference supply equipped with automatic cold-junction compensation was developed. (J.R.D.)

35773 (ORNL-3812(p.54-60)) MSRE REACTOR ANALYSIS. (Oak Ridge National Lab., Tenn.).

An analysis of the stability of the MSRE was completed. The study included latest values of the system parameters and the effects of uncertainties in these parameters and in the theoretical dynamics model. The system was found to be inherently stable, not only at the design point but for any combination of parameters within the predicted range of uncertainty. The effectiveness of borosilicate Raschig rings in suppressing criticality at the bottom of the reactor cell in event of rupture of the MSRE primary circulating system was evaluated. Use of commercially available rings containing 4% by weight natural B should ensure that a margin of subcriticality is maintained for any mixture of fuel salt and water that might be dumped into the bottom of the cell. The use of an unmoderated radial blanket of molten salt for improving the breeding capability of a single-fluid, graphite-moderated molten-salt breeder reactor was analyzed. When fuel inventories were taken into consideration, even for blanket thicknesses less than 1.5 ft, the gain in breeding ratio was not sufficient to compensate for the cost of the required additional U inventory in the radial blanket. (J.R.D.)

35774 (ORNL-3812(p.169-73)) FUEL PROCESSING. (Oak Ridge National Lab., Tenn.).

The design, procurement, and construction of the MSRE fuel processing system were essentially completed except for the salt sampler and the U absorption equipment. An electrolytic hygrometer is being tested for in-line monitoring of the removal of oxide from molten salt by treatment with H_2 and HF. Initial results are encouraging, but they indicate that HF will have to be completely removed from the gas that is bypassed to the analyzer. Study of methods for the removal of volatilized chromium fluoride from the off-gas stream during fluorination of molten salt has begun. Some data were obtained for the sorption of CrF_3 on NaF pellets at 400°C. (auth)

35775 (ORNL-TM-1026) EGCR CONTROL ROD DRIVE ENVIRONMENTAL TEST. Ferguson, W. F. (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 58p. Dep.(mn); $3.00(cy), 2(mn) CFSTI.

To assure reliable operation of reactor control rod drives, it is necessary that they be thoroughly tested in an environment similar to that of the reactor in which they are to be used. A prototype of the control rod drive mechanism proposed for use in the Experimental Gas-Cooled Reactor has been subjected to such a test program. It is concluded that the rod drive meets the functional requirements of the design specifications. (auth)

35776 (ORNL-TM-1143) A 3500-Mw(t) LOW-TEMPERATURE SODIUM-COOLED FAST BREEDER REACTOR FOR DESALINATION. Olson, R. C.; Carlsmith, R. S.; Hoskins, R. E. (Oak Ridge National Lab., Tenn.). June 10,

1965. Contract W-7405-eng-26. 67p. Dep.(mn); $2.00 (cy), 2(mn) CFSTI.

Preliminary design and economic studies of a 3500-Mw(t) low-temperature sodium-cooled fast breeder reactor concept for use in desalination applications are reported. The reactor consists of an oxide-fueled core and metallic uranium radial blankets operating at a reactor inlet temperature of 500°F and a mean outlet temperature of 800°F. Four applications of the reactor design are considered: central-station power plant, dual-purpose plant, self-contained plant, and single-purpose process-heat plant. Based on proposed desalination ground rules, this system produces prime steam for less than 9 cents per million Btu. As a central station power plant, the system is capable of producing power at 1.5 mills/kwhr. If power is valued at this price, process heat in the form of steam at 260°F can be delivered to an evaporator plant for about 9.5¢/MBtu from the single-purpose process heat plant, 8.2¢/MBtu from the self-contained plant, and less than 5¢/MBtu from a dual-purpose plant producing 420 Mw(e) over and above the auxiliary power requirements of the desalination complex. (auth)

35777 (ORNL-TM-1169) FAST FRACTURE ANALYSIS OF EGCR PRESSURE VESSEL. Berggren, R. G. (Oak Ridge National Lab., Tenn.). June 21, 1965. Contract W-7405-eng-26. 30p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

The structural adequacy of the EGCR pressure vessel shell, heads, and nozzle stubs relative to fast fracture was analyzed using an extension of the fracture analysis methods of Pellini and Puzak. The available information on ductile fast fracture of pneumatically loaded pressure vessels was incorporated in the analysis. Materials properties, pressure vessel stresses, and maximum flaw sizes were the basic parameters incorporated in the analysis. The design was found to be structurally adequate. (auth)

35778 (SRO-116) HEAVY WATER POWER REACTOR PROGRAM. Monthly Progress Report. (Savannah River Operations Office (AEC). Aiken, S. C.). May 1965. 15p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Research and development is reported on fuel channel assemblies, fuel elements, SAP cladding, reactor coolants, reactor physics, reactor control, reactor refueling, and large-plant engineering. Thorium fuel cycle development is reported in reactions on analytical methods, fuel element parameters, cladding materials, and cycle optimization for 1000-Mw(e) reactors. Research is also reported on heat transfer and Nb–Zr pressure tubes. Operation of the Carolinas-Virginia Tube Test Reactor is summarized. (J.R.D.)

35779 (SRO-117) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, JUNE 1965. (Savannah River Operations Office (AEC), Aiken, S. C.). 12p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Design studies of the fuel channel assembly of the HWOCR were made. Changes in the fuel assemblies are reported. A listing of the TONG computer code library was obtained for use in evaluating cross section data. Studies were started for the 1000 Mwe plant, of the support facilities for the refueling machine, and for the space requirements of the main carriage of the refueling machine. A fuel element parameter study and fuel cycle analyses were made. (M.O.W.)

35780 (TID-21842) HIGH-TEMPERATURE ENERGY SYSTEMS. Quarterly Progress Report, November 1, 1964–January 31, 1965. (Bureau of Mines, Morgantown, W. Va. Morgantown Coal Research Center). 16p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Progress in the development of closed-cycle gas turbine power systems for use as auxiliary power sources for space applications and with gas-cooled nuclear reactors for civilian power generation. Turbocompressor design conditions were established and tests were made on a self-sustaining closed-cycle gas turbine operating on hydrodynamic gas-lubricated bearings. Use of nuclear heat for coal gasification is also discussed. Two pilot-plant gas-circulating (helium) systems were constructed in which a vessel containing inductively heated graphite spheres simulated a nuclear reactor. The second loop operated at 250 psig in a 1000-hr test in which helium was heated to 2500°F. Gasification methods compatible with this system were developed. (M.C.G.)

35781 (TID-21953) FLOW MODEL STUDY OF THE EBR-II. Final Report, July 15, 1958–December 2, 1960. Rymsa, Daniel T.; Wachtell, George Peter (Franklin Inst., Philadelphia, Pa. Labs. for Research and Development). Contract W-31-109-eng-38, Subcontract 31-109-38-974. 178p. (F-A2201). Dep.(mn); $5.00(cy), 4(mn) CFSTI.

Prepared for Argonne National Lab., Ill.

A 0.6 scale flow model of the EBR-II was designed, constructed, and operated, along with one calibration loop for model subassemblies and another for prototype subassemblies. The prototype liquid sodium flow was modeled by means of water at 110°F (150°F water in the prototype subassembly calibration loop). Geometric scale modeling of the plenums and subassembly entrance and exit flow configurations was used, but the prototype fuel and blanket pin configurations in the subassembly upper sections were hydraulically modeled by means of orifices. Orifice diameters were selected so that, at the flow rate corresponding to full prototype Reynolds number, the overall model subassembly pressure drop was approximately equal to the value that exact model subassemblies would produce. With the aid of calibration data, selected orifices were used as flow meters in the assembled reactor flow model. Flow distribution measurements showed that there is a "pressure drop deficit" in the assembled model, which varies from row to row. This deficit is attributed to the interaction of the flows entering the subassemblies due to their close proximity. Measurements of static pressure near subassembly entrances supported this explanation. By obstructing the flows through all subassemblies in selected rows, the pressure drop deficit was expressed as a quadratic function of the flow distribution. The flow loop control valves were adjusted so that water was injected at one side of the model and withdrawn at the other side as well as at the normal exit. This procedure was followed to simulate the condition in the prototype in which one of the two pumps fails. No appreciable flow distribution asymmetry in the subassemblies appeared as a result. India ink was injected into selected subassemblies, to permit visualization of the flow in the upper plenum which was fitted with a transparent lid. High speed motion pictures were taken. Calibration loop data were taken to show the prototype control rod flow as a function of stroke. Appendixes contain illustrations and calibration curves of prototype and model subassemblies. (auth)

35782 (WCAP-6067) EVALUATION OF GAMMA ACTIVITY DISTRIBUTIONS IN YANKEE CORE I AND CORE II SPENT FUEL. Nodvik, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). June 1965. Contract AT(30-1)-3017. 160p. Dep.(mn); $5.00(cy), 3(mn) CFSTI.

The results of extensive gamma scanning measurements made on the Yankee Core I and Core II spent fuel are presented. Included in these measurements are gross gamma scans along the axis of fuel assemblies, single channel scans along the lengths of individual fuel rods, and multichannel scans at selected points along several fuel rods. Utilizing the values of burnup inferred from mass spectrometric and radiochemical analyses of the spent fuel, the gamma scans are evaluated as to their usefulness for determining burnup distributions, local burnup peaking factors, and gross core asymmetries. The effects of cladding impurities, cooling time, and the burnup and spectrum dependency of the fission product effective decay characteristics are discussed. (auth)

35783 NUCLEAR SAFETY FEATURES IN THE DESIGN OF POWER REACTORS. Eickelpasch, N. (Technischer Ueberwachungs-Verein Bayern e.V., Munich). Atomkernenergie, 10: 187-90(May-June 1965). (In German)

The most important safety features especially for pres-

surized-water reactors and boiling-water reactors and their mechanisms are noted. The influence of the reactivity coefficient is described for nuclear accidents of special reactors. An idea of the order of magnitude of all mentioned safety parameters is given. (auth)

35784 RECENT ACTIVITY AT ÅGESTA. Sandstroem, S. (Aktiebolaget Atomenergi, Studsvik, Sweden). Euro Nucl., 2, 221-2(May 1965).

The 65-Mw (thermal) Ågesta power plant was shut down for inspection in June, 1964, after its first year of operation. During the startup attempt in Sept. 1964, a leak was discovered between the heavy water system and the light water system which cools the vessel head. Repairs were completed by Feb. 1965, and the subsequent startup of the reactor was achieved in March, 1965, using nuclear heating instead of the electrical pre-heating method used in previous startups. (D.C.W.)

35785 SEEK AND YE SHALL FIND. Euro Nucl., 2: 222-3(May 1965).

The location and recovery of a camera and flash unit that were lost inside the pressure vessel of the No. 4 reactor at Calder Hall as they were being withdrawn through a fuel charging tube are summarized. The conditions inside the reactor are covered, together with the preparation and exposure of the personnel who recovered the camera unit. (D.C.W.)

35786 THE CIRENE PROJECT. Bahbout, A. (C.C.R., Euratom, Ispra, Italy); Villani, S. Euro Nucl., 2: 224-8(May 1965).

The CIRENE project is aimed at the development of a fog-cooled, heavy-water-moderated reactor fuelled with natural uranium. Characteristic problems, conceptual studies, heat transfer tests, materials tests, and reactor physics experiments are summarized. (D.C.W.)

35787 FUELLING AT TRAWSFYNYDD. Euro Nucl., 2: 229-32(May 1965).

The fuelling equipment and procedures at the Trawsfynydd power plant are discussed, including the operation of the fuelling machine. Notably, a single free-standing machine, moved by an overhead crane, undertakes all operations at the reactor standpipes. (D.C.W.)

35788 COMPUTER CONTROL OF POWER REACTOR. Miida, J. Genshiryoku Kogyo, No. 11, 49-53(1963). (In Japanese)

A brief review is given of the economic aspects of power reactor computer control. The use of a computer control for 75 Mw boiling reactor installed at Big Rock Point was used as an example to show that the computer control increased the burnup 4.5% but the gain in the burnup coefficient and the capital investment in the computer resulted in $18,000 loss per year. However, with 300 Mw reactor the burnup coefficient was increased up to 8%. Thus, the favorable features of computer control are stressed in case of high power reactors. (R.V.J.)

35789 WHY AGR? Fishlock, David. New Scientist, 26: 567-8(May 27, 1965).

The advanced gas-cooled reactor will be Britain's next nuclear power station. It is considered to have excellent possibilities as a power source for a flash-evaporation type of desalination plant. It has on-load refueling made economic by simpler core design, the fuel being uranium dioxide. There are also possibilities of coupling the reactor with a magnetohydrodynamic generator, and thus adding 10–15% to its thermal efficiency. (J.F.P.)

35790 LIGHT WATER REACTOR TECHNOLOGY. Nucl. Eng., 10: 211-12(June 1965).

Most light water reactors are of the pressure vessel type with no separation of the coolant and the moderator. This reduces thermal stress and thermal expansion problems and also gives an inherent control feature by means of the large negative temperature coefficient of reactivity. This reactor has further development to be made, and improvements aim at a simpler and more economic design. (J.F.P.)

35791 PWR OPERATING EXPERIENCE. Beatty, D. C. (Westinghouse Electric Corp., Pittsburgh). Nucl. Eng., 10: 213-16(June 1965).

The pressurized water reactor operated by the Yankee Atomic Electric Company was tested by gradual power increases, load drops, scram tests, and detailed calorimetrics at each loading. The operation of each of three cores was compared to the others in their various aspects. The operating history of BR-3 and Trino is also briefly reviewed. (J.F.P.)

35792 CONNECTICUT YANKEE. A DESCRIPTION OF THE WESTINGHOUSE PWR AT HADDAM NECK. Kilpatrick, J. N.; Beal, F. S. (Westinghouse Electric Corp., Pittsburgh). Nucl. Eng., 10: 216-20(June 1965).

A description is given of the reactor core, the rod cluster control, chemical shim control, in-core instrumentation, shaft seal pumps, steam generators, containment, and other engineering safeguards. Illustrations are included. (J.F.P.)

35793 THE EVOLUTION OF THE BOILING WATER REACTOR. McNelly, M. J. (General Electric Co., San Jose, Calif.). Nucl. Eng., 10: 222-4(June 1965).

Technological advances made on the boiling water reactor are discussed. The core design and fuel design improvements are described. Other developments such as the pressure suspension concept are also discussed. (J.F.P.)

35794 OYSTER CREEK. A DESCRIPTION OF THE VERY LOW CAPITAL COST PLANT FOR JERSEY CENTRAL. Nucl. Eng., 10: 225-8(June 1965).

A general description is given of the boiling water reactor, with emphasis placed on the pressure vessel, core, control rods, containment, auxiliary systems, and control station. A large drawing of the reactor is included with its parts labeled. (J.F.P.)

35795 BWR OPERATING EXPERIENCE. Perkins, K. T. (General Electric Co., San Jose, Calif.). Nucl. Eng., 10: 229-31(June 1965).

Operating experience gained from BWR's is summarized. Emphasis is placed on radioactive wastes handling, load-following flexibility, maintenance, plant operation, refueling, staffing, and operator training. It is concluded that the boiling water reactor has established its ability to provide safe, reliable power to meet the demands of any utility system. (J.F.P.)

35796 POWER REACTOR TECHNOLOGY. Volume 8, Number 2. Zinn, Walter H.; Dietrich, J. R. (Combustion Engineering, Inc., Dunedin, Fla. Nuclear Div.). Spring 1965. $0.70(GPO) (domestic), $0.90(GPO) (foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC).

Five sections are included on physics, fluid and thermal technology, fuel elements, components, and specific reactor types. Separate abstracts were prepared for each section. (M.J.T.)

For abstracts of individual sections see: 35620, 35621, 35719, 35737, and 35797.

35797 SPECIFIC REACTOR TYPES. Power Reactor Technol., 8: No. 2, 137-56(Spring 1965).

Studies evaluating the technical feasibility and economic potential of a 1000-Mw(e) nuclear power plant incorporating a single pressurized water reactor are discussed, including capabilities, pressure-vessel fabrication, steam-generator design data, containment, turbine-generator, cost, core design and fuel assemblies, thermal and hydraulic characteristics of reference and alternate cores, and shim and rod control systems. Operation of the EBWR is reviewed. Four design studies of a 1000-Mw(e) ceramic-fueled fast breeder reactor cooled with liquid sodium, using UO_2-PuO_2 or UC–PuC fuels, are reviewed, considering especially core arrangements and performance, fuel elements and assemblies, nuclear and safety characteristics, and physics and fuel-cycle evaluation. 51 references. (M.J.T.)

35798 INTEGRATION OF NUCLEAR ENERGY IN THE PRODUCTION OF ELECTRIC ENERGY. Ailleret, P. (Electricite, France). Rev. Gen. Elec., 74: 141-8(Feb. 1965). (In French)

It is shown that the competitivity of nuclear energy is attained due to very large power units; the cases in which these are integrable in a system are examined, taking into account the repercussions on the necessary reserves of connected load. This competitivity is based on a reliable knowledge of costs only for natural uranium-graphite channels and for enriched uranium and light water channels. The costs are compared and a general survey of future possibilities is given. The breeder is considered on the one hand from the angle of possible cost, on the other hand from the angle of consumption of natural resources. More general considerations on the risks of oil and uranium shortage are presented. (auth)

35799 INDUSTRIAL PROBLEMS IN THE DEVELOPMENT OF NUCLEAR ENERGY. Gibrat, R. Rev. Gen. Elec., 74: 149-55(Feb. 1965). (In French)

The questions which are set today by the industrial development of nuclear energy production are examined. The problems are reviewed of the choice of the type of reactor, the utilization of military uranium stocks becoming available in the eventuality of a general disarmament agreement, the competitivity of nuclear energy as confronted by conventional energy, the quality of construction required by the reactors and the preparation of French industry in approaching this construction. The question of world uranium reserves is studied, as well as that of the indispensable connection with foreign industries. Lastly, the positions taken in the United States of America and Great Britain on these different problems are analyzed, taking into account the investments required for nuclear plant and the anticipated price of the kilowatt-hour that they will supply. In conclusion, only regrouping will enable European manufacturers to re-establish the equilibrium desirable between the different forces of nuclear economy. (auth)

35800 BREEDER REACTOR RESEARCH. p.136-48 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

The development of fuels, cladding, and materials for breeder reactors is described, with emphasis on compatibility with liquid-metal coolants. Safety and sodium-loss reactivity coefficients are also studied. (T.F.H.)

35801 FACT BOOK ON U. S. NUCLEAR POWER PROJECTS. Sixth Edition. Published by Electric Companies Public Information Program. New York, Bozell and Jacobs, Inc., 1964. 84p.

Information on the costs, financing, ownership, design, location, contractors, operators, and status of the various power reactor projects in the United States is presented after a brief discussion of the approach to nuclear power development in the United States. The projects are classified by reactor types on the basis of the coolant used. (D.C.W.)

35802 FULL POWER OPERATION OF THE DOUNREAY FAST REACTOR. Phillips, J. L. (U.K.A.E.A. Dounreay, Caithness, Scotland). p.7-24 of ANS-100.

The Dounreay Fast Reactor was beset by two major engineering difficulties during its commissioning. Once these were overcome, the reactor very soon demonstrated the feasibility of the system as a power producer. At the same time, the limitations of the first design of a metallic fuel element were determined and an improved element evolved and put into use. The immediate effect was to permit the operation of the reactor at "full" power and provide valuable reaction rates in irradiation experiments in aid of advanced fuel development. Since high power operation was commenced, the performance of the fuel element has also enabled a very satisfactory load factor to be achieved for this experimental reactor, thus increasing its value to overall fast reactor development. Considerable practical experience has also been accumulated upon the behavior of system components. (auth)

35803 EBR-I AND EBR-II OPERATING EXPERIENCE. Novick, M.; McGinnis, F. D.; Whitham, G. K. (Argonne National Lab., Idaho Falls, Idaho). p.25-40 of ANS-100.

EBR-I was finally shut down after over 12 years' operation in a program which proved the feasibility of the fuels breeding concept, demonstrated the practicality of operating a reactor power plant with a liquid metal heat transfer system, provided useful information relative to the safety of fast reactors, and demonstrated that a fast reactor fueled principally with plutonium can be safely controlled by normal operators without any unusual special measures being taken. Except for the inadvertent meltdown of the second core in the course of experiments which were designed to investigate the transient behavior of the reactor, operation of EBR-I with four separate cores was without incident and met the requirements set forth in its design. Radiation levels throughout the plant were within acceptable levels, and no untoward system failures or effects were uncovered that would limit the continuation of the program to develop economic fast power breeder reactors. The startup of EBR-II has been delayed, not due to the primary malfunction of reactor components but rather to the prolonged facility construction period, the failure of a number of key items of commercial equipment, and the need to prove and improve various devices in the plant which are developmental and with which very little previous experience had been obtained. Operation of EBR-II has proved to be routine during periods when it was operable. Normal startup procedures can be completed and the reactor made critical in about 2 hr. Continuation to power proceeds smoothly, and the synchronization of the generator with the outside lines offers no difficulty. Prior to the shutdown in October, 1964, the reactor had accumulated a total of 16,928 Mwht (705 Mwdt) of operation and 3,459 Mwhe of electrical production. (auth)

35804 OPERATING EXPERIENCE AT THE ENRICO FERMI ATOMIC POWER PLANT. Alexanderson, E. L. (Power Reactor Development Co., Detroit, Mich.); Branyan, C. E.; Olson, W. R. p.41-56 of ANS-100.

FFBR operating data are summarized. Descriptions are given of low-power nuclear tests; performance of the safety systems, detectors, control rods and drives, and fuels; operation of the sodium and cover-gas systems; containment testing; and performance of fuel handling components and plant auxiliary systems for FFBR. (T.F.H.)

35805 MOBILE-FUELED FAST REACTORS: PASTE SYSTEMS. Kovacic, Evan C. (Atomic Power Development Associates, Inc., Detroit). p.75-82 of ANS-100.

The paste-fueled reactor concept is investigated. Studies of paste density, paste flow, and paste irradiation, and the effects of these parameters on paste mobility are reported. The pastes studied comprise settled beds of 100- to 200-μ fuel spheres in which a liquid metal is dispersed to improve the thermal and fuel-mobility characteristics. Materials evaluations, economic evaluations, and design studies for paste-fueled reactors are summarized. (T.F.H.)

35806 STEAM COOLED BREEDER REACTORS. Edlund, M. C.; MacMillan, J. H.; Schluderberg, D. C. (Babcock and Wilcox Co., Lynchburg, Va.). p.85-8 of ANS-100.

Fast reactor studies lead to the conclusion that steam at supercritical pressures shows promise of providing attractive power generating costs. With steam as a reactor coolant, a direct cycle can be used to reduce capital costs by eliminating the need for intermediate heat exchangers, boilers, and superheaters. The heat transfer and heat transport characteristics of supercritical steam result in nominal pumping power requirements and yield overall thermal efficiencies for the nuclear power plant of 43%. The combined simplicity of the direct cycle and high thermal efficiency of the supercritical steam plant provides the prospect of capital costs lower than other reactors thus far proposed. While the breeding ratio of the SCBR is expected to be lower than for sodium-cooled oxide breeders, the fuel inventory, fabrication, and reprocessing costs are expected to be nearly the same. At a plutonium price of $10/gram, the fuel cost of the SCBR should be no more than 0.1 to 0.2

mill/kwh higher than for a sodium cooled oxide fast breeder. The capital cost advantage of the direct cycle SCBR should more than offset this slight fuel cost disadvantage. Operation of a steam cooled breeder at supercritical pressures appears to be more economical than operating at lower pressures. For example, reducing the steam pressure to about 2000 psi lowers the net thermal efficiency of the plant from 43% to 38%. The capital cost of the plant would increase about $10/kw. The fuel cost is relatively insensitive to steam pressure, the increase in bred fuel being largely offset by increased fuel inventory cost. The long term prospects for operation with D_2O appear attractive. The D_2O inventory is estimated to be only about $6/kw. Thus, if operation of a direct cycle plant with D_2O proves practical, the breeding potential of a steam cooled breeder can be markedly improved at no penalty in generating cost. After accumulating operating experience with light water steam, conversion to D_2O may prove attractive as the economic incentive for improved breeding develops. (auth)

35807 DEVELOPMENT OF THE GAS COOLED FAST REACTOR CONCEPT. Fortescue, Peter; Shanstrom, R. T. (General Atomic Div., San Diego, Calif.); Fenech, Henri. p.89-98 of ANS-100.

With steel-canned carbide fuel and CO_2 cooling at 2000 psi, fuel ratings and power densities of the order of 1.75 Mw/kg and 600 kw/liter appear possible, while producing high enough gas temperatures to yield 41.5% over-all plant efficiency and retaining less than $1 reactivity swing for a 100,000 Mwd/tonne maximum burnup. The corresponding over-all conversion ratio is 1.6, leading to total system doubling times of around 4 yr and to substantially zero fuel cycle cost (with 4¾% fuel use and 10% working capital charges). Use of thorium instead of depleted uranium blankets (but with U-238 left as fertile material in the core) could further reduce fuel cycle costs by about 0.2 mill/kwh. In desalting applications, the system offers the interesting prospect of achieving as good economy in a single purpose plant as is obtainable in combined electric and desalting applications employing thermal reactors. (auth)

35808 HERMES—A MODULAR STEAM COOLED FAST BREEDER CONCEPT. Tavernier, G.; Chermanne, J.; Descamps, C.; Fossoul, E. (BelgoNucleaire, Brussels). p.99-104 of ANS-100.

The main problem of the "Hermes" concept is the mechanical fabrication of the core structure (essentially the modulus), and the gathering of moduli to realize the core structure. The other problems are common with other types of reactors and are partly or completely solved, i.e., cladding development (common with nuclear superheat); safety, mainly to avoid loss of coolant and power excursions; increases in the heat transfer performances in order to get compact cores; development of large steam circulators; and containment problems (common with water cooled reactors). No important development obstacle can be foreseen, and a prototype of 100 Mwt should be able to be built in a relatively short delay and a full scale power station should be possible 5 years later. The principal target is to reach a breeding ratio sufficiently high to lead a power station integrated in an over-all complex including its own reprocessing plant, starting with its first core and get self-sustaining. Once this point has been reached, continued interest in this concept will be subject to the kwh price. (auth)

35809 SIGNIFICANT FACTORS IN THE EVALUATION OF FAST REACTOR FUEL PERFORMANCE. Leitz, F. J. (General Electric Co., San Jose, Calif.). p.105-9 of ANS-100.

Low fuel cycle cost promises to be a major potential advantage of fast reactors over other power reactor systems. Selection of an optimum fuel for fast reactors requires the evaluation and balancing of many, at times conflicting, factors related to technical feasibility as well as economics and breeding. As in the evolution of most new developments, initial emphasis can be expected to concentrate heavily on the safety and reliability features. In the long term, breeding, insofar as it determines the availability of fuel for both existing and new reactors, will assume a prominent role. Thus, the optimum fast reactor fuel material and design may well change with time, rate, and direction of these changes depending on the progress made in the various fuel development programs. (auth)

35810 URANIUM-PLUTONIUM CARBIDE FUELS FOR FAST BREEDER REACTORS. Strasser, A. (United Nuclear Corp., White Plains, N. Y.); Wheelock, C.; Neimark, L. p.126-56 of ANS-100.

Uranium-plutonium carbide fuel has an excellent potential for producing the lowest fuel cycle cost among the three major fast breeder reactor fuels: metal, oxide, and carbide. Encouraging results have been obtained by irradiating the fuel up to an average of 37.6×10^{20} fiss/cm^3(114,000 Mwd/t) and 150 to 330 kw/kg (U + Pu). The microstructure is stable, diameter increase is 0.6% per a/o burnup, and fission gas release is less than for mixed oxides. The compatibility of the fuel with clad is excellent up to a minimum of 870°C. The (UPu)C and some of the significant UC property data are reviewed, and the conclusion reached that immediate goals can best be achieved by the use of hyperstoichiometric, helium contact-bonded and possibly hypostoichiometric, sodium-bonded (UPu)C, and future goals by stoichiometric or hyperstoichiometric (UPu)C, sodium or helium bonded. (auth)

35811 SEFOR—A STATUS REPORT. Wolfe, B.; Hikido, K.; Horst, K. M.; Reynolds, A. B. (General Electric Co., San Jose, Calif.). p.247-72 of ANS-100.

Engineering, research and development, construction, safety, test-facility, and contractual status of SEFOR is surveyed. The SEFOR site and facility are shown schematically. The characteristics of the reactor and its components are tabulated. (T.F.H.)

35812 STUDIES OF LARGE FAST REACTORS IN FRANCE AND WEST GERMANY. Zaleski, C. P. (Euratom-CEA Assoc., Cadarache, France); Smidt, D. p.275-94 of ANS-100.

In very pessimistic cases, the maximum reactivity insertion rate is approximately 50 dollars/second. Such rates do not penalize significantly the cost of primary containment. Besides this, it seems that the criterion that the isothermal sodium coefficient should be zero or negative for the whole reactor is not justified. Indeed two different reactors, the first satisfying the criterion and the second not, yield similar reactivity ramps. Thus it is concluded that the results are strongly dependent upon the flux-flattening method and the spatial distribution of the sodium coefficient. (auth)

35813 WORLD FORECAST OF NUCLEAR CAPACITY TO 1965. Merlin, H. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Toronto, Canadian Nuclear Association, 1965, Preprint No. 65-CNA-200, 63p. (CONF-650515-15). ORINS

From International Conference and Exhibition of Canadian Nuclear Assn., Quebec.

The demand for nuclear energy and the way the demand is met are discussed. Included are charts of electric energy consumption, installed capacity forecasts, and energy resources of various countries. (J.F.P.)

35814 RAJASTHAN ATOMIC POWER PROJECT. Smith, W. J. (Montreal Engineering Co. Ltd.). Toronto, Canadian Nuclear Association, 1965, Preprint No. 65-CNA-202, 15p. (CONF-650515-13). ORINS

From International Conference and Exhibition of Canadian Nuclear Assn., Quebec.

The development of the Rajasthan atomic power project is described. The various problems encountered are described including that of transportation. The selection of a CANDU-type reactor, the Indian resources, the contribution of Indian industry, and the schedule of construction are included. Also included are maps of the area. (J.F.P.)

35815 NUCLEAR FUEL COST TRENDS UNDER PRIVATE OWNERSHIP. Graham, Richard H. (General Electric Co., San Jose, Calif.). 34p. (CONF-650429-2)

From American Power Conference, Chicago.

The status of fuel ownership and current fuel-cycle technology are summarized, together with the implications of private ownership. The factors determining fuel-cycle costs are then outlined; and estimates of fuel costs under private ownership throughout the life of a 600-Mwe boiling reactor are given, assuming a life of 30 yr and initial operation in 1970. (D.C.W.)

35816 THE 1965 BOILING WATER REACTOR. Richards, R. B. 26p. (CONF-650429-5)

From American Power Conference, Chicago.

The status of boiling water reactor design and technology, as typified by the second Dresden power plant, is summarized. The design features of the present boiling reactor are compared with those of the first Dresden plant. The future development of the boiling water reactor is also briefly considered. (D.C.W.)

35817 TECHNICAL STATUS AND ECONOMIC POSSIBILITIES OF USING PLUTONIUM. Wagner, Harvey A. (Detroit Edison Co.). 9p. (CONF-650429-8)

From American Power Conference, Chicago.

The economic possibilities and technical status of using plutonium as a reactor fuel are outlined, with consideration of programs on the utilization of plutonium in both fast and thermal reactors and of future programs. (D.C.W.)

35818 RECENT ADVANCES IN HIGH-TEMPERATURE, GAS-COOLED REACTORS. LeClair, T. G.; Rickard, C. L. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). 20p. (CONF-650429-10; GA-6288)

From American Power Conference, Chicago.

The building and demonstration operation of the Peach Bottom prototype and the design, development, and testing of components for large HTGR plants have made real progress toward the improved nuclear power plant characteristics being sought with the HTGR system. The work allows the following conclusions: HTGR high temperature operation will permit overall plant efficiency in the range of 39% to 45%; the neutron economy of the system is excellent and in large plants will permit high conversion ratios and, with specialized loading of fuel, thermal breeding; HTGR's appear to have exceptionally low fuel-cycle costs which are insensitive to possible changes in uranium ore prices; the system has potential for 1000 Mw(e) and higher unit size. The proposed 330,000-kw HTGR plant for Colorado and a continuing development program in the HTGR field are steps toward larger and more economic HTGR plants. (auth)

35819 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR PLANTS. (to Sulzer Brothers Ltd.). British Patent 989,593. Apr. 22, 1965. Priority date Sept. 10, 1962, Switzerland.

A method of controlling a nuclear reactor plant is described, in which reactor power output is adjusted immediately in response to a change in plant load, but the speed of circulation of the heat carrier is controlled by a device that measures the neutron flux in the reactor. Increase in speed of circulation is thus effected only as actual heat output of the reactor increases, so that delivery of low-temperature heat carrier to the vapor generator is avoided. (A.G.W.)

35820 IMPROVEMENT IN OR RELATING TO POWER GENERATION. (to Babcock and Wilcox Ltd.). British Patent 990,028. Apr. 22, 1965. Priority date Aug. 6, 1960, France.

A method of producing power is patented in which fluid in each of a plurality of closed circuits is vaporized by heating in a vaporizing zone and passed to a condensing zone of the circuit. Each closed circuit is incorporated in an engine so that, between the vaporizing zone and the condensing zone, the vapor discharges through jets to produce power. Either combustion appliances or a nuclear reactor may be used as a source of heat. A power plant may include a plurality of units, each having two closed systems. (A.G.W.)

35821 STEAM COOLED NUCLEAR REACTOR SYSTEM WITH IMPROVED FUEL ELEMENT ASSEMBLY. Vann, Harold E.; Crowley, John H. (to Jackson and Moreland, Inc.). U. S. Patent 3,178,354. Apr. 13, 1965. Filed July 25, 1961.

A steam-cooled reactor system produces superheated steam and uses that steam directly in an electrical power generating system. Removable modular subassemblies are used in the reactor, each of which includes fuel element, moderator, coolant flow tube, a chamber for radioactive products, and coolant-leak detection means. Slightly superheated steam introduced into the reactor as coolant is highly superheated as it passes through the coolant tubes. One portion of the highly superheated steam is applied directly to a high-pressure turbine stage, and the high-pressure turbine exhaust is reheated by a second portion of the steam. The reheated steam is then applied to a lower-pressure turbine stage. (A.G.W.)

35822 VAPOR COOLED NUCLEAR REACTOR. Brunner, Alfred (to Sulzer Freres, S.A.). U. S. Patent 3,180,798. Apr. 27, 1965. Priority date Feb. 27, 1960, Switzerland.

The reactor patented is used as a superheater for an operating medium entering the reactor as a dry superheated vapor at a relatively low superheat temperature and leaving the reactor at a relatively high superheat temperature. Part of the highly superheated vapor is used for evaporating the liquid operating medium contained in a vessel outside the reactor, and a second part is used for drying and slightly superheating the vapor, which is then introduced into the reactor. The balance of the highly superheated vapor is available for operating a turbine. Multiple coolant circuits are so arranged that highly superheated vapor is used as coolant for relatively cool fuel elements and slightly superheated vapor is used as coolant for relatively hot fuel elements. The distribution of the highly superheated vapor is controlled automatically. (A.G.W.)

35823 BOILING WATER NUCLEAR REACTOR SYSTEM. West, John M.; Weems, Sterling J. (to Combustion Engineering, Inc.). U. S. Patent 3,180,802. Apr. 27, 1965. Filed Dec. 20, 1960.

The core of a boiling water reactor system is divided into a number of flow passages from the center of the core outward. A pump is used to force water through the central core region. The outlet of the central passage is connected with a drum outside the pressure vessel, in which steam and water are separated. The water is conveyed by natural circulation through the outer regions of the reactor core; the steam is conveyed to a point of use. (A.G.W.)

35824 BOILING WATER REACTOR WITH DIVIDED CORE. Gibbons, John F. (to Combustion Engineering, Inc.). U. S. Patent 3,180,803. Apr. 27, 1965. Filed Dec. 20, 1960.

A coolant circulating system for a boiling water reactor is partially dependent on a circulation pump. The reactor core is divided into vertical passageways through which water is passed upward in parallel flow relation. A drum located outside the pressure vessel and higher than the core is connected by a downcomer with the lower region of the pressure vessel in which the lower ends of the core passageways communicate. Some of the core passageways communicate at their upper end with the drum and others are open to the reactor pressure vessel. Water is pumped from the reactor pressure vessel into the elevated drum where steam and water are separated. The water is recirculated and the steam is conveyed to a point of use. (A.G.W.)

35825 BOILING COOLANT REACTOR WITH INTEGRAL VAPOR SEPARATION AND NUCLEAR SUPERHEAT. Ammon, Johannes H. (to Babcock and Wilcox Co.). U. S. Patent 3,185,630. May 25, 1965. Filed Dec. 1, 1960.

A boiling coolant reactor is adapted to both separate and superheat the vaporized coolant. The reactor has a liquid collecting space and a vapor collecting space with a coolant liquid level separating the two spaces. Fuel element assem-

blies are disposed within the reactor so that most of their length is below the liquid level. Each assembly is capable of boiling the vaporizable coolant flowing through the reactor, separating the coolant into its liquid and vapor portions, and superheating the vapor portion as it recirculates through the fuel assembly. The fuel element assembly includes a plurality of elongated tubular elements positioned below and in axial alignment with its corresponding vapor-liquid separator, and both are laterally enclosed by wall means to form a riser chamber in which the coolant flows over the fuel elements. These wall means with the separator form an annular passageway to convey the vapor-liquid coolant from the riser chamber to the separator. The separated vapor coolant is superheated inside the tubular fuel element. To avoid the temperature limitations imposed by certain materials used as cladding for tubular fuel elements, different metals may be used as cladding for the boiling and superheating sections of the element. (B.L.M.)

Production Reactors

35826 (BNWL-SA-99) ANALOG SIMULATION OF HANFORD DUAL PURPOSE REACTOR PLANT. Coughren, K. D.; Swanson, C. D.; Thieme, G. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 9, 1965. Contract AT(45-1)-1830. 27p. (CONF-650319-1). Dep.(mn); $2.00(cy), 1(mn) CFSTI.

From Northwest Simulation Council Meeting, Richland, Wash.

An analog simulation of the dual purpose Hanford N-reactor was undertaken. Studies were performed to determine the dynamic characteristics of the plant and to determine possible plant, operator, and control system malfunctions. Various operational procedures and proposed design changes were also studied. The simulation of the reactor plant was made up of a series of subsystems which were coupled together. Each subsystem was studied in detail previous to being assembled into the total reactor plant simulation. Analog studies showed that it was possible to predict dynamic characteristics resulting from spurious transients such as reactor scrams and component failures. In addition, study of system control methods revealed certain desirable modifications to the reactor primary coolant and secondary heat dissipation system. Approximate controller settings were determined, by use of the simulation, which increased the stability of both the primary and secondary systems. It is shown that an entire reactor plant, including a heat dissipation system, can be successfully simulated and that simulation results are useful as guidelines in complex plant operation and control. (auth)

Propulsion and Space

See also ENGINEERING — Space Propulsion.

Refer also to abstracts 34353 and 34355.

35827 (GEMP-338) UTILIZATION OF A ONCE-THROUGH TWO-TUBE BOILER IN THE DEVELOPMENT OF A CONTROL SYSTEM FOR THE 630A NUCLEAR STEAM GENERATOR. Glover, D.; Flitner, D. P. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Jan. 1965. Contract AT(40-1)-2647. 10p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The use of the boiler proved that it was possible to control the steam generator using integrated feedwater and airflow control loops. Test data verified the steady state analytical predictions for the boiler operation. It was also determined that the flow instability normally present in once-through boilers could be suppressed by orifices in the inlet to the boiler tubes. (auth)

35828 (GEMP-341) 630A MARK IV MARITIME NUCLEAR STEAM GENERATOR SUMMARY REPORT. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Feb. 26, 1965. Contract AT(40-1)-2847. 9p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

A summary description and bibliography pertaining to Mark IV design are presented. (M.O.W.)

35829 (GEMP-342) 630A MARK V MARITIME NUCLEAR STEAM GENERATOR STATUS REPORT. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Feb. 26, 1965. Contract AT (40-1)-2847. 231p. Dep.(mn); $6.00(cy), 5(mn) CFSTI.

Two concepts of the 630A Mark V Nuclear Steam Generator are described. The Mark V(A) uses a calandria-type reactor in which the fuel elements are contained within a reactor vessel suspended from the shield plug. The Mark V(B) uses a tube-type reactor with no calandria. The fuel elements are supported by the moderator tubes extending from the shield plug. Studies indicate that either of these concepts is feasible; however, the Mark V(B) appears most attractive and its features are emphasized. Following a description of the 630A Nuclear Steam Generator and system operation, succeeding sections present in detail a description of the major components, accessories, waste handling, and plant safety. The appendix provides detailed specifications and operating conditions. (M.O.W.)

35830 (GEMP-344) 630A CRITICAL EXPERIMENT TEST RESULTS, FEBRUARY 4, 1964–NOVEMBER 2, 1964. Pincock, G. D.; Jacoby, M. A.; Archibald, G. R. Jr. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Feb. 19, 1965. Contract AT (40-1)-2847. 275p. Dep.(mn); $6.00(cy), 7(mn) CFSTI.

The 630A Critical Experiment test results obtained from February 5, 1964 to November 2, 1964 are presented. Two reactor loadings were used during this report period. The first series of measurements was with the second loading of the 630A. The only change was in reducing the number of shim rods from 132 to 96. This was done to increase the power in the outer fuel cartridges thus giving a more desirable gross radial power distribution. The second fuel loading was to simulate an end-of-life condition. No attempt was made to mockup fine radial or longitudinal burnup or fission product poisons. Detailed power distribution measurements were obtained from both fuel loadings. Other measurements were made to determine $k$excess, rod worths, boron-steel (burnable poison) worth, shutdown capability with the reactor flooded and scrammed, moderator temperature coefficient of reactivity, heating rates, and a facility radiation survey. (auth)

35831 (GEMP-353) TECHNICAL CONSIDERATIONS LEADING TO THE SELECTION OF THE SERPENTINE-INVOLUTE DESIGN FOR THE 630A BOILER. Bonini, B.; Flitner, D. P.; Cook, R. G. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Mar. 31, 1965. Contract AT(40-1)-2847. 8p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

The ground rules for selecting the boiler design for the 630A Nuclear Steam Generator are outlined. Three designs from different vendors are described: serpentine involute, helical coil, and flat spiral. Results of a tentative evaluation of the designs are that the serpentine involute design is superior with regard to repair and replacement of tubes and to simplicity and compactness of design. (D.L.C.)

35832 (HW-84384(p.9.1-5)) PHYSICS. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Data and discussion concerning the shutdown characteristics of ^{233}U, ^{235}U, and ^{239}Pu in propulsion reactors are presented. (J.R.D.)

35833 (LA-DC-6546) PERIOD EQUILIBRIUM EFFECTS IN THE START-UP OF NUCLEAR ROCKET REACTORS. Singer, Sidney (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1962]. Contract W-7405-eng-36. 23p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

It is shown that the small-signal transfer function of a nuclear reactor whose power is increasing at constant period is different from that of a reactor at constant power level. A reactor power control system designed for adequate stability using a power equilibrium reactor transfer function may therefore be unstable if the reactor power is forced to increase on a sufficiently short period. For a nuclear rocket reactor, such an instability is most likely to occur during the very rapid reactor startup to full power. The results of this analysis are applied to the KIWI B1-A log-power reactor control system, and it is shown that the system originally designed using a power equilibrium reactor transfer function was unstable for periods shorter than about two seconds. A re-analysis of the system using a period equilibrium transfer function resulted in a control system stable for any period longer than about 0.5 sec. (auth)

35834 (N64-33133) INTRODUCTION TO NUCLEAR PROPULSION. LECTURE 21. NUCLEAR ROCKET SYSTEM. Motsinger, Russell E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.). 1963. Contract NAS8-5215. 64p. (GEMP-190n(Pt.A); NASA-CR-52964) $3.00(CFSTI)

Some aspects of the demands of the nuclear rocket system as a whole are presented, viz., how the addition of the need to provide shielding for manned space capsules aboard the vehicle is likely to affect the minimum weight of the system and how well such requirements are compatible with nuclear reactor capability. (M.O.W.)

35835 (N64-33781) INTRODUCTION TO NUCLEAR PROPULSION. LECTURE 14. REACTOR CONTROL APPLICABLE TO NUCLEAR SPACE CRAFT. Gorker, G. E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 1963. Contract NAS8-5215. 78p. (GEMP-190i; NASA-CR-52944) $3.00 (CFSTI)

Factors which influence the thrust control system requirements of a nuclear powered vehicle based upon several different missions are discussed. Some general propulsion control system requirements are discussed. Four types of control systems and some of the systems which may be classified in each category are given. Some advantages and disadvantages of each system were itemized. (M.O.W.)

35836 (N64-33782) INTRODUCTION TO NUCLEAR PROPULSION. Lectures 17 and 18—Materials for Nuclear Application. Conway, J. B.; Muehlenkamp, G. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Apr.-May 1963. Contract NAS 8-5215. 55p. (GEMP-190L; NASA-CR-52947). $3.00(CFSTI).

A discussion of nuclear propulsion systems for space application is given, emphasizing materials selection from the point of view of nuclear properties and radiation effects, operating temperature capabilities, chemical properties, mechanical strength, thermal properties, and fabrication capabilities. Fuel elements (including fuel and matrix materials and cladding), moderators and reflectors, control elements, shielding, structure, reactor coolants, and property measurements are considered. (M.J.T.)

35837 (R62FPD20) SHADOW SHIELD DESIGN FOR SPACE POWER PLANTS. Englesson, G. A. (General Electric Co., Evendale, Ohio. Flight Propulsion Lab. Dept.). Jan. 9, 1962. 48p.

Two nuclear reactor shields were designed for a 1 Mw system utilizing a flat, exposed, thermal radiator. One of the shields was made of a laminar assembly of B_4C discs; the other was made part of the primary loop and utilized the coolant lithium as the shield material. Included with the shield design is a brief engineering discussion of shielding for gamma and neutron radiation. (auth)

35838 (TID-3582) NS SAVANNAH. A Literature Search. Lanier, Sidney F. (comp.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). July 1965. 44p. Dep.(mn); $2.00(cy), $0.50(mn) CFSTI.

A total of 189 annotated references to reports, books, journal articles, and conference papers are cited, covering research, development, and other aspects of the NS Savannah nuclear merchant ship. Personal author and report-number indexes are included. (auth)

35839 NUCLEAR ROCKETS. Spence, Roderick W. Intern. Sci. Technol., No. 43: 58-65(July 1965).

The development of nuclear rockets is considered. A discussion of the various problems peculiar to rockets is given. A note is made of the mass being more precious than energy. The homogeneous solid-core graphite reactor is illustrated. (J.F.P.)

35840 SPACE APPLICATIONS OF FAST REACTORS. Ott, David G. (Westinghouse Electric Corp., Pittsburgh). p.57-64 of ANS-100.

The Russians have successfully operated Romashka, a high temperature, fast reactor coupled to a thermoelectric power conversion system. This is the first operation of a small fast-reactor space power plant. While Romashka is only a laboratory demonstration, it clearly heralds the beginning of fast reactor applications to space power. The status of fast reactor technology in space is discussed, and Romashka is examined along with the various fast reactor concepts which are being considered in the United States space program. This discussion is concerned with nuclear auxiliary power reactors, i.e., reactors providing prime heat power to drive an electrical generating system in space. The general characteristics of space reactors are delineated to provide a backdrop for the descriptive discussion of Romashka and four United States fast space reactors. Some of the design and performance characteristics which differentiate fast and thermal space reactors are described. Finally, some of the differences between large, commercial, fast reactors and compact, fast, space reactors are mentioned. (auth)

35841 REACTOR ANALYSIS. Watson, Clayton W. (Univ. of Florida, Gainesville). p.348-425 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

After a discussion of reactor analysis problems, the problems of estimating the energy and spatial distributions of neutron populations are considered, with emphasis on reactors of the KIWI type. Specialized formations of the neutron transport equations are presented, and mathematical approximations for obtaining solutions to these equations are outlined. Monte Carlo techniques for solution of transport problems are considered in some detail. (D.C.W.)

35842 REACTOR PHYSICS BACKGROUND FOR NUCLEAR ROCKET APPLICATIONS. Vreeland, John A. (Aerojet-General Corp., Azusa, Calif.); Watson, Clayton W. p.443-74 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

General approaches to the solution of the Boltzmann transport equation are briefly discussed, and some special formulations of the Boltzmann equation are described. Mathematical approximations for obtaining solutions of the Boltzmann equation are then outlined, and the generation of cross sections is discussed. The applicability of the techniques covered to the design of rocket reactors is evaluated. (D.C.W.)

35843 RADIATION ENVIRONMENTAL ANALYSIS. Graves, Glen A. (Los Alamos Scientific Lab., N. Mex.). p.475-613 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

A survey on the difficulties and approaches to the analysis of the radiation environment, shielding, and safety of rocket reactors is presented. 104 references. (D.C.W.)

35844 NUCLEAR REACTOR KINETICS AND CONTROL. Uhrig, Robert E. (Univ. of Florida, Gainesville). p.614-71 of Nuclear Rocket Propulsion. Gainesville, Fla., University of Florida, 1964.

Techniques for the analysis of linear reactor systems are outlined. The determination of complicated transfer functions is considered, together with stability criteria. The ef-

fects of moderator temperature and of gaseous hydrogen moving through the core of a rocket reactor on the transfer function are calculated. The transfer function for a reactor system using three modes of control is derived, with consideration of the hydrogen and temperature coefficients of reactivity. (D.C.W.)

Research and Test Reactors

Refer also to abstract 35570.

35845 (CEA-R-2725) APPLICATION DE METHODES STATISTIQUES A L'ESSAI DES ENSEMBLES DE COMPTAGE NUCLEAIRE. (Application of Statistical Methods to the Testing of Nuclear Counting Assemblies). Gilbert, Jean-Pierre; Friedling, Georges (Commissariat à l'Énergie Atomique, Cadarache (France). Centre d'Études Nucléaires). Apr. 1965. 40p. Dep.(mn).

The application of the hypothesis test theory to the control of the statistical purity and of the stability of the counting batteries used for measurements on activation detectors in research reactors is described. The principles involved and the experimental results obtained at Cadarache on batteries operating with the reactors PEGGY and AZUR are given. (auth)

35846 (CONF-650602-23) STANDBY CONDITION OF THE HWCTR. Arnett, L. M. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [June 1965]. Contract AT(07-2)-1. 20p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

The operation of the HWCTR was terminated because of the decision to redirect the work on this reactor concept to reactors that are organic-cooled. An extensive description of the steps taken to place the HWCTR in standby condition is included. (M.O.W.)

35847 (IDO-17084) SPERT PROJECT. Quarterly Technical Report, October–December 1964. Crocker, J. G., ed. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1965. Contract AT(10-1)-205. 42p. Dep.; $2.00(cy), 1(mn) CFSTI.

With the completion of the experimental program with the close-packed, D_2O-moderated core, nuclear operations in the Spert II facility were suspended, and the facility was placed on a standby status. The experimental program with the Spert III plate-type core was completed with the performance of a series of transient tests initiated at high power levels. Results of this series of tests were generally predictable from previous tests performed under less extreme plant conditions and from pretest calculations using the ART-04 computer code. No damage to the core resulted from any of the tests in this series. The Spert III facility is being prepared for an experimental program with a low-enrichment oxide core to investigate the dynamic behavior of such cores under typical PWR conditions. Preparations for nuclear operation of the Capsule Driver Core (CDC) in the Spert IV facility were completed. A series of tests was performed to determine if strain gauges mounted on the outside of CDC capsules can be used to measure internal transient pressures. It was determined in these tests that the strain gauges can be used to give reasonably accurate internal pressure measurements. The fuel for the PBF will consist of a ternary mixture of urania diluted with calcia-stabilized zirconia. It was determined that the phase stability of these mixtures is sufficient to permit their use in the PBF. Also, the solidus and liquidus temperatures and the thermal conductivities at 800 to 2200°C were determined for both mixtures. (J.R.D.)

35848 (NP-15077) APPLICATION TO THE UNITED STATES ATOMIC ENERGY COMMISSION FOR CONSTRUCTION PERMIT AND OPERATING LICENSE. SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. PART I AND II AND SUPPLEMENTS. Preliminary Safeguards Summary Report. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). [nd]. 710p. (DOCKET-50-231) Dep.(mn); $10.10(cy), 12(mn) CFSTI

A survey is presented of the SEFOR design and operating characteristics; plant site and environment; containment; reactor and plant safety; instrumentation and safety systems; radioactive waste disposal; research programs; operating procedures and startup; and safety evaluation. (T.F.H.)

35849 (RT/FI(64)-16) FORMA DELLE RIGHE γ ORIGINATE DALLA CATTURA DI NEUTRONI IN UN REATTORE TERMICO. (Shape of γ Lines Produced by Neutrons Captured in a Thermal Reactor). Giannini, M.; Prosperi, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Sept. 1964. 11p. Dep.(mn).

In the last years the monochromatic γ lines produced in a thermal reactor by means of (n,γ) reactions have been employed for resonant nuclear scattering (or absorption) studies. In order to analyse these experiments one needs to know the spectrum F(E) of the employed γ lines. This spectrum was calculated taking into account the effective velocity distributions of neutrons and capturing nuclei. For thermal neutrons, the spectrum has a gaussian shape $\exp[-\alpha^2(E-E_0)^2]$. A numerical evaluation for a Fe source and the vertical tube of the research reactor RC1, shows that the distortion introduced by the epithermal neutrons is noticeable only for $(E-E_0) \geq 10$ ev. (auth)

35850 INVESTIGATION OF THE POWER EFFECT IN BR-5 REACTOR. Krasnoyarov, N. V.; Nikol'skii, R. V.; Efimov, I. A. At. Energ. (USSR), 18: 474-7(May 1965). (In Russian)

Studies were made of the power effects with various coolant flow rates in the BR-5 reactor. A method was developed for estimating the power effect of components related to the warm up of the fuel element core. A special experiment was carried out with sodium consumption of 28 m^3/h and constant incoming sodium temperature and corresponding coolant superheating at 30, 60, 80, and 100°C. The results showed linearity at 0 to 70°C and considerable deviation at temperatures exceeding 70°C. (R.V.J.)

35851 EXPERIMENTAL STUDIES OF THERMAL CYCLE OF VVR-M REACTOR FUEL ELEMENTS. Barchuk, I. F.; Nazarchuk, M. M.; Ogorodnik, S. S.; Polipets, D. T.; Slesarevskii, S. O. At. Energ. (USSR), 18: 528-9 (May 1965). (In Russian)

The measurements of the temperature distribution along the surface length of fuel elements distributed in the active zone near the water barrier, beryllium reflector, and control rods showed very little temperature variation on the surface side facing the water or the active zone. The position of the coolant channels has a strong effect on the fuel element temperature. The fuel element temperature on the side of the coolant is lower than the other side. The highest heat intensity in the active zone was found in the periphery near the beryllium reflector. The measurements showed that with coolant consumption of 530, 960, and 1300 m^3/hr the maximum reactor power is 6, 10, and 12 Mw, respectively. The temperature of the cooling water discharged from the active zone is 60 to 62°C. The diagram of the temperature distribution along the surface of the fuel element length in a 12 Mw reactor and coolant consumption of 1300 m^3/h showed that the cooling system for the VVR-M reactor has a sufficiently high reserve factor. (R.V.J.)

35852 A FAST PNEUMATIC TRANSFER TUBE FOR THE TRIGA MARK II-REACTOR. Huebner, K. (Oesterreichische Hochschule, Vienna). Atomkernenergie, 10: 169-71(May-June 1965). (In German)

A fast pneumatic transfer tube installed at a Triga Mark II-reactor is described. The transfer time is 0.05 sec. The system is available in the steady-state and in the pulsed use of the reactor. In the latter application the system is controlled by the Cherenkov radiation of the core. The activity of a short-lived state during a pulse as a function of lifetime is described and a measurement of lifetime of ^{12}B is presented. (auth)

35853 CRYSTAL SPECTROMETER MEASUREMENT OF CEKMECE TR-1 THERMAL NEUTRON SPECTRUM. Akyuez, Oemuer; Bayvas, Fehime; Cansoy, Cetin; Domanic,

Fahri (Atomic Energy Commission, Istanbul). Nukleonik, 7: 189-92(Apr. 1965).

The thermal neutron spectrum of Cekmece TR-1 was measured using a double crystal spectrometer and a NaCl crystal with its (200) plane as monochromator. The neutron energy which corresponds to the maximum of thermal flux distribution was found to be $E_0 = 0.0595$ ev. Assuming the flux distribution to be Maxwellian an attempt was made to analyze the measured data to evaluate the effective neutron temperature in the beam hole. Because the theoretical expressions previously given were found to be unsatisfactory in representing neutron reflectivity for slow neutrons, an experiment was carried out to determine the reflectivity in dependence of neutron energy. The results of the experiment showed that the reflectivity is proportional to $E^{-0.45}$. By using this empirical relation the effective neutron temperature was found to be ≅337°K. (auth)

35854 NORDHEIM EQUATION ACCORDING TO P_1-APPROXIMATION. Ertek, Cetin; Gencay, Sarman; Guersu, Yurtcan (Atomic Energy Commission, Istanbul). Nukleonik, 7: 200-2(Apr. 1965).

A Nordheim type equation relating the reactivity to the stable and transient periods of the reactor is established within the frame of P_1-approximation according to a method elaborated by A. Y. Ozemre, and its characteristics are investigated and compared to equations given by the elementary diffusion theory. (auth)

35855 CRITICAL ASSEMBLIES. Thalgott, F. W. (Argonne National Lab., Idaho Falls, Idaho); Baker, A. R.; Carpenter, S. G. p.225-43 of ANS-100.

Descriptions are given of ZPR-III, ZPR-VI, Zero Power Plutonium Reactor, Epithermal Critical Experimental Facility, ZEBRA (UK), VERA (UK), BFS (USSR), SNEAK (Germany), and Masurca (France) critical assemblies. Studies in ECEF of the Advanced Epithermal Thorium Reactor are described. The characteristics and operating parameters of the critical assemblies are tabulated. (T.F.H.)

35856 FAST REACTOR TEST FACILITY (FARET) INITIAL EXPERIMENTAL PROGRAM. Simmons, W. R.; Persiani, P. J.; Bump, T. R. (Argonne National Lab., Ill.). p.273-4 of ANS-100.

The initial experimental programs planned for FARET (a 50 Mwt sodium-cooled test facility for fast reactors) are noted. (T.F.H.)

WASTE DISPOSAL AND PROCESSING

See also BIOLOGY AND MEDICINE — Ecology.
CHEMISTRY — Radiochemistry.
CHEMISTRY — Separation Processes and Procedures.
HEALTH AND SAFETY.

Refer also to abstract 34302.

35857 WASTE DISPOSAL. Reactor Fuel Process., 8: 111-23(Spring 1965).

The treatment of liquid wastes by foam separation and freeze drying is discussed briefly. Development of methods for the conversion of high-level-activity wastes to solids by calcination and glass fixation is reviewed. Final disposal methods (hydraulic fracturing in shale and calcined-solids storage in salt mines) are also discussed. Work on the recovery of fission products from wastes is surveyed. Other literature on waste treatment and disposal is reviewed. (D.L.C.)

35858 MANAGEMENT OF RADIOACTIVE WASTES. p.166-80 of "Fundamental Nuclear Energy Research, 1964." Washington, D. C., Atomic Energy Commission, 1964.

Studies of rivers and subsurface hydrology at Hanford, Oak Ridge, and Idaho Falls are described. Oceanographic and meteorological studies of release of radioisotopes to the atmosphere and to oceans are in progress. Treatment of low- and high-activity wastes is described. Waste disposal in geologic formations is detailed. Evaluations are carried out of various waste management methods. (T.F.H.)

GENERAL AND MISCELLANEOUS

35859 (BNWL–113–1) PLUTONIUM ABSTRACTS. Volume 5, Number 1. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 10, 1965. Contract AT(45-1)-1830. 16p. Dep.; $1.00(cy), 1(mn) CFSTI

Twenty-two abstracts are presented on new developments in plutonium technology. They are arranged under the following headings: biology and medicine, chemistry, health and safety, metallurgy and ceramics, physics, and reactor technology. (D.L.C.)

35860 (BNWL–113–3) PLUTONIUM ABSTRACTS. Volume 5, Number 3. (Ba'telle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 30, 1965. Contract AT(45-1)-1830. 21p. Dep.; $1.00(cy), 1(mn) CFSTI

Thirty-seven abstracts are presented on new developments in plutonium technology. They are arranged under the following headings: chemistry, health and safety, metallurgy and ceramics, physics, and reactor technology. (D.L.C.)

35861 (LA-DC-6520) FORMULAS FOR STEREOSCOPIC DISPLAY. Lewis, H. R. Jr. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [n.d.]. Contract W-7405-eng-36. 14p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

General formulas are derived with which stereoscopic projections of a set of points can be computed. The derivation includes a simple and direct procedure for specifying the effective interocular separation, location, and orientation of an observer in a convenient form. Stereoscopic projections prepared according to these formulas, for example with computing equipment which records information on 35 mm film, can be viewed with standard techniques. (auth)

35862 (LA-DC-6583) MENGOVIRUS REPLICATION. III. VIRUS PRODUCTION IN CHINESE HAMSTER OVARY CELLS. Tobey, Robert A.; Campbell, Evelyn W. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 20p. Dep.(mn); $1.00 (cy), 1(mn) CFSTI.

The interactions of Mengovirus with the nontumorigenic Chinese hamster ovary (CHO) diploid cell line resembled those of the Mengovirus-L cell system. Approximately 200 new virus particles were produced in each infected CHO cell within 6 to 7 hours. Protein and RNA synthesis in infected cells paralleled virus maturation, although the release of virus particles from cells was delayed by 100 minutes. (auth)

35863 (LA-DC-6588) POLYPHENYLALANINE SYNTHESIS DIRECTED BY BROMINATED POLYURIDYLIC ACID. Smith, David A. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 6p. Dep.(mn); $1.00(cy), 1(mn) CFSTI

Brominated poly U when mixed with equimolar amounts of poly A has a decreased hypochromicity compared to poly U–poly A mixtures (Yu and Zamecnik, 1964). This has been interpreted to mean that bromination of uracil residues weakens the hydrogen-bonding potential for adenine residues. This report demonstrates that brominated poly U is at least as active as poly U in stimulating polyphenylalanine formation in a cell-free protein synthesizing system (Nirenberg and Matthaei, 1961). (auth)

35864 (NP-15087) BRIEF ANNUAL REPORT, 1964–1965. (Department of Atomic Energy, Bombay (India)). 52p. Dep.(mn).

Activities of the Atomic Energy Commission of India during 1964 and part of 1965 are reviewed briefly. The Apsara reactor was shut down in Jan. 1965, after 8 yr of operation, for fuel replacement. The 40 MW reactor, CIR, was operated with an output of 8,619 MWD during 1964. The 14 experimental beam holes were used for a number of research programs. The Zerlina reactor was operated with a total power output of 18,809 watt hours during 1964. Basic design information and cost estimates were prepared for a prototype power reactor fuelled by natural UO_2 enriched with Pu and moderated with D_2O. Research and development activities during the period are outlined. No technical data are included. (C.H.)

35865 (NYO–2043–108, pp 49–69) SOIL CHEMISTRY. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)).

During a period of approximately 18 mo of the eruption of the volcano Irazu in Costa Rica, a large amount of volcanic ash covered the west-southwest part of the country to a depth of several inches. Results are reported from a study of the chemical nature of this volcanic ash, greenhouse studies on the productivity of fresh ash and ash-compost mixtures; the acidity and exchangeable Al content of tropical soils; and the effects of fertilizers on the chemical properties of tropical soils. (C.H.)

35866 (NYO-2391-11) SCATTERING OF LONG WAVELENGTH PHONONS BY POINT IMPERFECTIONS IN CRYSTALS. Krumhansl, J. A.; Matthew, J. A. D. (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). June 1965. Contract AT(30-1)-2391. 29p. Dep.(mn); $2.00(cy), 1(mn) CFSTI

At very low temperatures the thermal conductivity of insulating crystals containing point defects is limited by boundary relaxation processes and by Rayleigh scattering of long wavelength phonons; at higher temperatures resonant modifications of Rayleigh scattering and phonon-phonon scattering dominate. Experiments on the thermal conductivity of alkali halide crystals containing monovalent impurities indicate that the inverse relaxation time computed from experiment for Rayleigh scattering is in some situations very much less than that calculated on the assumption that the defects are isotopic impurities. Since the scattering of phonons in a one dimensional chain may be discussed without approximation, the problem was solved and results show that mass and spring changes round the imperfection may give compensating contributions to the scattering amplitude; the scattering power of the center may thereby be reduced to below the value calculated on the basis of pure isotope scattering. A generalization of these ideas not dependent on Born approximation is presented using formal scattering theory adapted to handle this case. (auth)

35867 (NYO-2471-2) ELECTRONIC PROPERTIES OF SURFACE LAYERS OF SILVER CHLORIDE. Report No. 242. Snavely, Benjamin B. (Cornell Univ., Ithaca, N. Y. Materials Science Center). Aug. 17, 1964. Contract AT(30-1)-2471. 33p. Dep.(mn); $2.00(cy), 1(mn) CFSTI

Electron schubweg and mobility in surface layers, approximately 10 μ thick, of nominally pure silver chloride crystals were studied by observing the photoconductivity produced by 0.2 μsec pulses of 1.5 Å x rays. The photoresponses for oxygen-free and oxygen-doped crystals are compared with thermally stimulated currents observed after traps had been filled by prior irradiation at 80°K, and with x-ray pulse excited luminescence at 80°K. The photoelectron range is controlled by traps some of which must be deep, i.e., traps from which thermal emission of electrons is impossible below 300°K. These traps are present in a density in excess of 10^{15} cm^{-3} and are destroyed, to a large extent, by oxygen. The probability for radiative recombination of free electrons is small compared to the probability for trapping at temperatures from 85°K to 300°K in both oxygen free and oxygen doped crystals. Surface region mobility measurements in crystals containing oxygen yield values for the mobility comparable to the bulk region values at temperatures above 150°K. Evidence

for trapping and re-emission of trapped electrons is presented for the temperature range below 150°K. (auth)

35868 (ORNL-3793) THE ORNL BOOK CIRCULATION CONTROL SYSTEM. Haeuslein, G. K.; Dickison, R. R.; Haas, A. S. (Oak Ridge National Lab., Tenn.). July 1965. Contract W-7405-eng-26. 27p. Dep.(mn); $2.00(cy), 1 (mn) CFSTI.

The ORNL Central Research Library is transferring the filing and copying operations of its book circulation control system to a computer. Each book contains a punched book card. An IBM 357 Data Collection System is employed to generate machine-readable records about each transaction. A short description of the manual charging system applied up till now is followed by detailed instructions for the use of the automated version. All circulation data are recorded on magnetic tape. A description is given of the tape files used and the formats by which circulation data are recorded and printed. The generation of the punched book cards is covered. Finally, the actual implementation of the automated book circulation control system is briefly described. Data flow charts of the system are included. (auth)

35869 (ORNL-P-1339) PROBABILISTIC ESTIMATES OF RANGE FORAGE INTAKE. Van Dyne, G. M. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 6p. (CONF-650709-1). Dep.(mn); $1.00(cy), 1(mn) CFSTI

From American Society of Animal Science, Fort Collins, Colo.

Forage intake is never measured directly in grazing studies, but estimates of mean forage intake are obtained indirectly by lignin ratio, chromogen ratio, fecal nitrogen index, or microdigestion techniques. Estimates of dietary composition are usually obtained from a group of esophageal or ruminal fistulated animals and estimates of quantity and composition of fecal output are obtained from a separate group of animals. No measure of precision is obtained with these techniques, however, because estimates of forage intake obtained thereby apply to the group rather than to individual animals. In addition to an estimate of the mean forage intake, it is desirable to have a knowledge of the distribution about that mean. A method is described for generating a population of forage intake values about the mean value of forage intake so that the nature of the distribution may be examined. The method is applied to data from range nutrition studies in which microdigestion techniques were used to calculate mean forage intake. Equations used in the calculations are included. (C.H.)

35870 (ORNL-P-1340) DISTANCE TRAVELED BY SHEEP ON WINTER RANGE. Van Dyne, G. M.; Van Horn, J. L. (Oak Ridge National Lab., Tenn. and Montana State Coll., Bozeman. Dept. of Animal and Range Sciences). [1964]. Contract W-7405-eng-26. 6p. (CONF-650709-2). Dep.(mn); $1.00(cy), 1(mn) CFSTI.

From American Society of Animal Science, Fort Collins, Colo.

Distance traveled by a band of sheep grazing on a foothill range of about 1620 hectares in south-central Montana was measured in the winter of 1960. The band's travel route during 31 days was plotted on aerial photographs. The distance traveled by three wethers in the band was measured for 41 sheep-days with metering devices harnessed to the sheep. The average distance traveled by individual sheep was 1.6 times that measured from aerial photographs for band travel. Wind movement, temperature, and relative humidity were measured winterlong. The calculated distance traveled by sheep in the band averaged winterlong was 7.6 km. Elevation climbed each day, determined from 12.2 m interval contour maps, varied from 85 to 280 m. Energy expenditure for grazing, calculated using Blaxter's constants of 0.030 and 0.322 kcal/m respectively for horizontal and vertical movement for a 50 kg sheep, varied from 137 to 406 kcal/day per sheep. The average energy expenditure for grazing, 235 ± 62 kcal/day of which less than 3% was expended for climbing, represents about 20% of the basal metabolic requirement. Dietary samples collected from seven esophageal fistulated ewes grazing in the band were analyzed for crude protein, ether extract, lignin, and cellulose which averaged, respectively, 7.0, 3.1, 14.8, and 41.6% during the winter. Wind movement was the most important climatic variable affecting energy expenditure by the grazing sheep. There was no apparent lag influence of climate on energy expenditure for grazing. (auth)

35871 (SC-DC-64-2086) WEAR TESTING OF PLATED COATINGS. Jennings, C. W. (Sandia Corp., Albuquerque, N. Mex.). [Apr, 1965]. Contract AT(29-1)-789. 102p. (CONF-650430-1) Dep.(mn), $4.00(cy), 2(mn) CFSTI

From Western Electric Interworks Conference on Electroplating, Indianapolis.

An investigation was performed to determine the wear characteristics of combinations of electroplated metals for use in sliding contacts of rotary switches. Excessive wear was found for a number of switches plated with Rh and Ni by different commercial suppliers. To simulate this wear, specimens were electroplated under controlled conditions and tested for wear resistance with a wear tester that was similar in operation to the switch. There was no apparent correlation between wear resistance and conditions of electroplating other than thickness of the deposits. Other sources which could cause excessive wear are listed. A thin film of soft Au (~30 millionth thick) electroplated on a hard substrate of Rh on electroless Ni or bright Ni was found to provide better wear characteristics than the Rh on Ni system. A few tests were run on NeyOro G boards and ion-plated Au on alumina substrates. The latter combination, which had excellent wear characteristics, shows considerable promise for high temperature or corrosive applications. (auth)

35872 (SCL-DR-65-60) CIRCUIT-BOARD PRODUCTION BY COMPUTER METHODS. James, L. A. (Sandia Corp., Albuquerque, N. Mex.). June 1965. Contract AT(29-1)-789. 20p. Dep.(mn); $1.00(cy), 1(mn) CFSTI.

Circuit-board production can be improved by the use of numerically controlled machine fabrication techniques. A coordinate digitizer is used to efficiently extract information from design layouts. The layout is reduced to the elements of a drawing: points, lines, and circles. A drilled hole is considered a point, a terminal area can be called a spot, and a conductor path in a series of straight lines. By the use of these analogies, a computer can be instructed to generate a punched tape, which is then used to direct machines in preparation of boards or templates. The technique, while not yet fully developed, promises to eliminate much of the time involved in the production of handmade masters, as well as to improve the accuracy of the finished product. (auth)

35873 (TID-21021) ONE-SIDED NORMAL TOLERANCE FACTORS—NEW TABLES AND EXTENDED USE OF TABLES. Burrows, G. L. (Knolls Atomic Power Lab., Schenectady, N. Y.). [1962]. Contract W-31-109-eng-52. 27p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

Statistical tolerance limits are a quality evaluation method for demonstrating compliance with engineering drawing tolerances. Tables are presented of one-sided tolerance factors based on means and variances from unequal sample sizes. The tables are shown to be useful in providing exact tolerances in cases where zero mean normal measurement error is added to normal process variability and the ratio of variances is known, and in optimally allocating measurements among different items of production and repeated measurements on the same item. (D.L.C.)

35874 (UCRL-7807) THE AERODYNAMIC HEATING OF A VEHICLE TRAVELING AT SUPERSONIC VELOCITIES THROUGH A COMPRESSIBLE FLUID. Harri, John (Lawrence Radiation Lab., Univ. of California, Livermore). July 23, 1964. Contract W-7405-eng-48. 44p. Dep.(mn); $2.00(cy), 1(mn) CFSTI.

An equation is derived which describes the wall temperature of a vehicle traveling at supersonic velocities through a compressible fluid. A solution of this equation

is obtained by the use of the 7094 computer for both laminar and turbulent boundary layers using the Van Driest boundary layer shear stresses. Example calculations pertaining to the High Altitude Diagnostics rocket are included to demonstrate the use of the theory. (auth)

35875 THE MEXICAN COMMISSION OF NUCLEAR ENERGY. Ortiz Tirado, Jose (Comision Mexicana de Energia Nuclear, Mexico DF). Ciencia Interam., 4: 8-12 (Nov.-Dec. 1963). (In Spanish)

Educational, research, and radioprotection programs of the Commission are outlined. (BBB)

35876 FUNDAMENTAL NUCLEAR ENERGY RESEARCH, 1964. (Division of Plans and Reports (AEC), Washington, D. C.). Dec. 1964. 310p. $2.00(GPO)

Nineteen sections are included, in four major interest areas. Separate abstracts have been prepared for all the sections. (T.F.H.)

For abstracts of individual sections see: 33956, 33957, 34098, 34099, 34101, 34286, 34594, 34624, 34633, 35008, 35181, 35510, 35560, 35622, 35623, 35624, 35723, 35800, and 35858.

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ä	becomes	ae
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ø		oe
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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is identifiable by the absence of a report number.

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium — isotopes He-4 or Helium — He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid — methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ζ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names, are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly. Cross references appear in the index cumulations. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

Specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Whenever it appears that such information would be useful, descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract. Such phrases are written so that the idea considered most important is presented first. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium–allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been

omitted from such phrases provided no ambiguity results from the omission.

For entries concerned with physics, if the modifier does not indicate whether the reference is experimental or theoretical, a symbol E or T or E/T is given.

Conferences

Proceedings of conferences and conference papers are included in the Report Number Index.

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612498	19-34769	$3.00(CFSTI)
612536	19-34215	$2.00(CFSTI)
612538	19-34423	$4.00(CFSTI)
612602	19-34993	$1.00(CFSTI)
612632	19-35518	$3.00(CFSTI)
612677	19-34466	$3.00(CFSTI)
612710	19-34994	$2.00(CFSTI)
612737	19-35230	$4.00(CFSTI)
612806	19-34770	$2.00(CFSTI)
612810	19-34737	$2.00(CFSTI)
612901	19-34995	$5.00(CFSTI)
612912	19-34625	$12.10(CFSTI)
612914	19-35371	$1.00(CFSTI)
613011	19-34291	$1.00(CFSTI)
613014	19-34467	$2.00(CFSTI)
613030	19-35183	
613037	19-35519	$3.00(CFSTI)
613042	19-35231	$3.00(CFSTI)
613047	19-34341	$4.00(CFSTI)
613049	19-34771	$1.00(CFSTI)
613073	19-34860	$1.00(CFSTI)
AE–	**(Non-AEC)**	
184	19-35347	Dep.(mn)
187	19-35735	Dep.(mn)
AEC-tr–	**(For complete listing see TID-4025)**	
6578	19-34380	Dep. mn; CFSTI, $1.00 cy, 1 mn; JCL; $2.60 fs, $0.86 mf
AECL–	**(Canadian)**	
2252	19-34468	Dep.; $0.50(AECL)
AEET–	**(Indian)**	
201	19-34266	Dep.(mn)
AFAL-TR–	**(Non-AEC)**	
65-53	19-34423	See AD-612538
AFAPL-TR–	**(Non-AEC)**	
65-5	19-34771	See AD-613049
AFCRL–	**(Non-AEC)**	
64-560	19-34992	See AD-612471
64-733	19-34360	See AD-608225
64-749	19-34832	$1.00(CFSTI)
64-804	19-35515	See AD-608478
64-891	19-34291	See AD-613011
64-935	19-34737	See AD-612810
64-948	19-35227	See AD-609844
64-954	19-35182	See AD-610070
65-59	19-35228	See AD-611326
65-81	19-35231	See AD-613042
65-86	19-35519	See AD-613037
65-87	19-35518	See AD-612632
AFOSR–	**(Misc.)**	
64-1340	19-35516	See AD-609482
65-0429	19-34215	See AD-612536
AFWL-TR–	**(Non-AEC)**	
65-3	19-35562	CFSTI
AGN-TM–		
410	19-35749	Dep.(mn); $6.00(cy), 4(mn) CFSTI
AI–	**(Misc.)**	
64-159	19-34465	See AD-603666
65-36	19-34466	See AD-612677
ANL–		
6963	19-34772	Dep.; $1.00(cy), 1(mn) CFSTI
7045	19-35603	Dep.; $3.00(cy), 2(mn) CFSTI
ANL-Trans–		
177	19-35406	Dep.(mn); $1.00(cy), 1(mn) CFSTI; $1.60(fs), $0.80(mf) JCL
206	19-35587	Dep.(mn); $1.60(fs), $0.80(mf) JCL
ANS–	**(Non-AEC)**	
100	19-35725	American Nuclear Society, Detroit, Mich.
ANU-P–	**(Australian)**	
349	19-35372	Dep.(mn)
APDA–	**(Misc.)**	
169	19-35750	Dep.(mn); $3.00(cy), 2(mn) CFSTI
170	19-35608	Dep.(mn); $3.00(cy), 2(mn) CFSTI
BAW–	**(Misc.)**	
393-1	19-35751	Dep.(mn); $3.00(cy), 2(mn) CFSTI
3238-7	19-34319	Dep.(mn); $3.00(cy), 2(mn) CFSTI
BM-RI–	**(Misc.)**	
6640	19-34135	Free(Bureau of Mines)
BMI-X–		
256	19-34652	Dep.(mn); $2.00(cy), 1(mn) CFSTI
10129	19-34672	Dep.(mn); $4.00(cy), 2(mn) CFSTI
BNL–		
903	19-35373	Dep.(mn); $1.00(cy), 1(mn) CFSTI
8222	19-34738	Dep.(mn); $1.00(cy), 1(mn) CFSTI
8223	19-34739	Dep.(mn); $1.00(cy), 1(mn) CFSTI
8245	19-35014	Dep.(mn); $1.00(cy), 1(mn) CFSTI
8360	19-33736	Dep.(mn); $1.00(cy), 1(mn) CFSTI
8366	19-34559	Rev. Sci. Instr., 36: 887-900(1965)
8398	19-33735	Radiation Botany, 5: 205-22(1965)
8948	19-35483	Phys. Rev., 139: B295-9(1965)
9037	19-34519	Nucl. Instr. Methods, 35: 301-8(1965)
9094	19-35222	Phys. Letters, 16: 269-70(1965)
9111	19-35581	Dep.(mn); $1.00(cy), 1(mn) CFSTI
9115	19-34190	Phys. Letters, 17: 103-4(1965)
9142	19-35161	Phys. Rev. Letters, 14: 862-6(1965)
9188	19-34397	Dep.(mn); $1.00(cy), 1(mn) CFSTI
9195	19-35374	Dep.(mn); $1.00(cy), 1(mn) CFSTI
9258	19-35171	Phys. Rev. Letters, 15: 85-9(1965)
BNWL–		
38	19-35703	Dep.; $2.00(cy), 1(mn) CFSTI
52	19-35752	Dep.(mn); $1.00(cy), 1(mn) CFSTI
58	19-34740	Dep.(mn); $2.00(cy), 1(mn) CFSTI
62	19-34469	Dep.(mn); $1.00(cy), 1(mn) CFSTI
79	19-34626	Dep.(mn); $4.00(cy), 2(mn) CFSTI
84	19-35609	Dep.(mn); $3.00(cy), 1(mn) CFSTI
113-1	19-35859	Dep.; $1.00(cy), 1(mn) CFSTI
113-3	19-35860	Dep.; $1.00(cy), 1(mn) CFSTI

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BNWL-C–		
43	19-33714	Dep. mn; CFSTI, $2.00 cy, $0.50 mn
BNWL-SA–		
3	19-34102	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6	19-33986	Dep.(mn); $1.00(cy), $1.00(mn) CFSTI
10	19-34256	Dep.(mn); $1.00(cy), 1(mn) CFSTI
62	19-34424	Dep.(mn); $1.00(cy), 1(mn) CFSTI
76	19-34292	Dep.(mn); $1.00(cy), 1(mn) CFSTI
78	19-33737	Dep.(mn); $1.00(cy), 1(mn) CFSTI
99	19-35826	Dep.(mn); $2.00(cy), 1(mn) CFSTI
125	19-34398	Dep.(mn); $3.00(cy), 2(mn) CFSTI
134	19-34293	Dep.(mn); $2.00(cy), 1(mn) CFSTI
177	19-34673	Dep.(mn); $1.00(cy), 1(mn) CFSTI
BRL-TN–	(Non-AEC)	
1533	19-34290	See AD-609289
CALT–		
63-8	19-35482	Phys. Rev., 139: B288-95(1965)
68-23	19-34837	Astrophys. J., 141: 1303-5(1965)
CAPE–		
1200	19-34422	EM
1208	19-34451	EM
1209	19-34452	EM
1224	19-34454	EM
1252	19-34455	EM
1253	19-34456	EM
1254	19-34453	EM
CEA-R–	(French)	
2545	19-34103	Dep.(mn)
2725	19-35845	Dep.(mn)
2735	19-34674	Dep.(mn)
2736	19-35375	Dep.(mn)
2765	19-34470	Dep.(mn)
2795(Vol.I)	19-35736	Dep.(mn)
CERN–	(European Organization for Nuclear Research)	
65-13	19-34471	Dep.(mn)
65-18	19-34803	Dep.(mn)
65-20	19-34773	Dep.(mn)
65-23	19-34804	Dep.(mn)
CNLM–	(Misc.)	
6246	19-34640	Dep.(mn); $1.00(cy), 1(mn) CFSTI
CONF-320–	19-34923 19-34964	(International Conference on Cosmic Rays, Jaipur, India, Dec. 1963)
CONF-446–	(American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964)	
85	19-35709	See WAPD-T-1673
CONF-458–	(3rd Annual Symposium on High Temperature Conversion Heat to Electricity, Tucson, Ariz., Feb. 1964)	
3	19-35002	See TID-7687(Suppl.)
CONF-521–	19-35267	(5th Space Science Symposium, Florence, May 1964)
CONF-578–	(Conference on the Physics of Electromagnetic Separation Methods, Orsay, France, July 1962)	
2	19-34613	ORINS
3	19-34615	ORINS
4	19-34616	ORINS
5	19-34614	ORINS
6	19-34457	ORINS
7	19-34608	ORINS
8	19-34458	ORINS
9	19-34612	ORINS
10	19-34829	ORINS
11	19-35511	ORINS
12	19-34611	ORINS
13	19-35512	ORINS
14	19-34609	ORINS
15	19-35513	ORINS
16	19-34610	ORINS
CONF-649–	(12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964)	
28	19-34114	See WAPD-T-1662
CONF-735–	(National Meeting of the American Association for Contamination Control, Los Angeles, May 1964)	
2	19-34295	See SC-R-65-888
3	19-34304	See SC-R-65-903
CONF-758–	(American Physical Society Meeting, New York, Jan. 22–25, 1965)	
25	19-34472	Dep.(mn); $1.00(cy), 1(mn) CFSTI; Gmelin, AED-CONF-65-003-53
CONF-630804–	19-33730	(Symposium on Cell Differentiation and Somatic Mutation, Ohmiya-machi, Ibaraki-ken, Japan, Aug. 8–9, 1963.
CONF-641210–	(American Physical Society Meeting, Berkeley, Calif., Dec. 1964)	
17	19-35376	Dep.(mn); $1.00(cy), 1(mn) CFSTI
CONF-641217–	(IBM Symposium on Scientific Computers, Yorktown Heights, N. Y., Dec. 1964)	
1	19-33741	See UCRL-16053
CONF-650113–	(Western States Veterinary Conference, Las Vegas, Nev., Jan. 1965)	
1	19-33737	See BNWL-SA-78
CONF-650302–	(IAEA Symposium on Personnel Dosimetry for Accidental High-Level Exposure to External and Internal Radiation, Vienna, Mar. 1965)	
21	19-33986	See BNWL-SA-6
22	19-33958	See ORNL-P-1446
CONF-650316–	(25th Annual Conference on Physical Electronics, Cambridge, Mass., Mar. 24–26, 1965)	
1	19-34996	
CONF-650319–	(Northwest Simulation Council Meeting, Richland, Wash., Mar. 19, 1965)	
1	19-35826	See BNWL-SA-99
CONF-650401–	(American Chemical Society, Detroit, Apr. 4–9, 1965)	
4	19-34137	See IS-1055
CONF-650407–	(International Symposium on Fission Product Release and Transport Under Accident Conditions, Oak Ridge, Tenn., Apr., 1965)	
4	19-34408	See ORNL-P-1313
5	19-34407	See ORNL-P-1265
6	19-34409	See ORNL-P-1324
CONF-650414–	(19th Metallographic Group Meeting, Oak Ridge, Tenn., Apr. 20–22, 1965)	
13	19-34687	See ORNL-P-1266
CONF-650415–	(National Academy of Sciences Protective Structures Symposium, Washington, D. C., Apr. 20, 1965)	
1	19-34397	See BNL-9188
CONF-650417–	19-35725	(American Nuclear Society, National Topical Meeting on Fast Reactor Technology, Detroit, Apr. 26–28, 1965) See also ANS-100
CONF-650423–	(International Conference on Physics of Solids and High Pressures, Tucson, Apr. 19–21, 1965)	
2	19-35581	See BNL-9111
CONF-650429–	(American Power Conference, Chicago, Apr. 27–29, 1965)	
1	19-35640	ORINS
2	19-35815	ORINS
5	19-35816	ORINS
8	19-35817	ORINS
10	19-35818	ORINS
CONF-650430–	(Western Electric Interworks Conference on Electroplating, Indianapolis, Apr. 27–29, 1965)	

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1	19-35871	See SC-DC-64-2086
CONF-650432–	**(53rd General Conference of Pacific-Northwest Trade Assn., Portland, Oreg., Apr. 12, 1965)**	
1	19-34293	See BNWL-SA-134
CONF-650434–	**(AEC-NASA Liquid Metals Information Meeting, Oak Ridge, Tenn., Apr. 1965)**	
1	19-34640	See CNLM-6246
CONF-650511–	**(20th Annual American Society Quality Control Technical Conference, Los Angeles, May 3–5, 1965)**	
1	19-34256	See BNWL-SA-10
CONF-650515–	**(International Conference and Exhibition of the Canadian Nuclear Assn., Quebec, Canada, May 9–12, 1965)**	
3	19-35639	ORINS
13	19-35814	ORINS
15	19-35813	ORINS
CONF-650519–	**(13th Annual Conference of American Society of Testing Material Committee E-14, St. Louis, Mo., May 16–21, 1965)**	
1	19-34424	See BNWL-SA-62
CONF-650522–	**(Meeting of American Society for Testing Materials, Washington, D. C., May 11, 1965)**	
1	19-34673	See BNWL-SA-177
CONF-650529–	**(Health Physics Certification Training Course, Richland, Wash., May 1965)**	
1	19-34398	See BNWL-SA-125
CONF-650602–	**(American Nuclear Society 11th Annual Meeting, Gatlinburg, Tenn., June 20–24, 1965)**	
23	19-35846	Dep.(mn); $1.00(cy), 1(mn) CFSTI
CONF-650604–	**(International Symposium on Working Methods in High Activity Hot Labs., Grenoble, France, June 15–18, 1965)**	
7	19-34292	See BNWL-SA-76
CONF-650606–	**(EURATOM Symposium on Fuel Cycles of High-Temperature Gas-Cooled Reactors, Brussels, June 10–11, 1965)**	
8	19-34653	See GA-6399
CONF-650613–	**(American Chemical Society, 20th Northwest Regional Meeting, Corvallis, Oregon, June 14, 1965)**	
2	19-34110	See RL-SA-38
CONF-650706–	**(International Conference on the Study of Nuclear Structure with Neutrons, Antwerp, July 19–23, 1965)**	
2	19-35403	See ORNL-P-1354
4	19-35400	See ORNL-P-1343
5	19-35404	See ORNL-P-1371
7	19-35401	See ORNL-P-1346
9	19-35402	See ORNL-P-1353
10	19-35399	See ORNL-P-1307
11	19-35398	See ORNL-P-1304
12	19-35397	See ORNL-P-1302
15	19-35374	See BNL-9195
CONF-650709–	**(American Society of Animal Science, Fort Collins, Colo., July 12–14, 1965)**	
1	19-35869	See ORNL-P-1339
2	19-35870	See ORNL-P-1340
CONF-650803–	**(IAEA Symposium on Nuclear Materials Management, Vienna, Aug. 30–Sept. 3, 1965)**	
1	19-34102	See BNWL-SA-3
2	19-34656	See ORNL-P-1431
COO–		
7-353	19-35435	Nucl. Phys., 71: 157-60(1965)
30-100	19-35102	Nuovo Cimento (10), 38: 634-7(1965)
427-45	19-34882	Phys. Rev., 139: 1050-62(1965)
652-14	19-35753	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1088-12	19-34216	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1148-96	19-34136	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1318-1	19-34595	Dep.(mn); $4.00(cy), 3(mn) CFSTI
CVNA–	**(Misc.)**	
155	19-34399	Dep.(mn); $2.00(cy), 1(mn) CFSTI
D–	**(Misc.)**	
1-82-0406	19-34770	See AD-612806
DASA–	**(Misc.)**	
1266-4	19-34361	See AD-609555
1480	19-35230	See AD-612737
DESY–	**(German)**	
65/3	19-35015	Dep.(mn)
DMIC–	**(Non-AEC)**	
212	19-34651	See AD-612490
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EANDC–	**(European-American Nuclear Data Committee)**	
43(U)	19-35377	Dep.(mn)
EANDC(E)–	**(European-American Nuclear Data Committee)**	
57(U)	19-35378	Dep.(mn)
EOS–	**(Non-AEC)**	
4000-Final	19-34998	See N64-26578
ER–	**(Misc.)**	
5997	19-35563	See NP-15098
ERP–	**(Non-AEC)**	
82	19-35231	See AD-613042
ESD-TDR–	**(Non-AEC)**	
65-26	19-34377	See AD-609851
EUR–	**(European Atomic Energy Community)**	
2053	19-34641	See EURAEC-1223
2181.e	19-35704	Dep.(mn)
2340	19-35754	See EURAEC-1379
2347	19-34592	See EURAEC-1384
2353	19-34338	See EURAEC-1393
2354	19-34675	See EURAEC-1394
2363	19-34676	See EURAEC-1404
2403.e	19-35610	Dep.(mn)
2416.e	19-35705	Dep.(mn)
EURAEC–		
1223	19-34641	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1266	19-35626	See SROO-207-30
1366	19-34319	See BAW-3238-7
1379	19-35754	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1384	19-34592	Dep.(mn); $3.00(cy), 2(mn) CFSTI
1393	19-34338	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1394	19-34675	Dep.(mn); $3.00(cy), 1(mn) CFSTI
1404	19-34676	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1410	19-34677	See GA-6454
1411	19-35758	See GEAP-4899
F–	**(Misc.)**	
A2201	19-35781	See TID-21953
FTD-MT–	**(Non-AEC)**	
64-284	19-34775	CFSTI
FTD-TT–	**(Non-AEC)**	
65-63	19-35530	$1.00(CFSTI)
GA–	**(Misc.)**	
5137	19-35434	Nucl. Phys., 71: 129-56(1965)
5559	19-35755	Dep.; $4.00(cy), 3(mn) CFSTI
5948	19-35362	Nukleonik, 7: 192-9(1965)
5968	19-35348	Dep.(mn); $2.00(cy), 2(mn) CFSTI
6238	19-35455	Phys. Letters, 16: 235-7(1965)
6288	19-35818	See CONF-650429-10
6399	19-34653	Dep.(mn); $1.00(cy), 1(mn) CFSTI

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6454	19-34677	Dep.(mn); $1.00(cy), 1(mn) CFSTI
GCA-TR-	**(Misc.)**	
64-5-N	19-34862	See N64-27381
GEAP-	**(Misc.)**	
3863	19-35756	Dep. mn; CFSTI, $2.00 cy, $0.50 mn
4754	19-34743	Dep.(mn); $2.00(cy), 1(mn) CFSTI
4810	19-35757	Dep.(mn); $5.00(cy), 4(mn) CFSTI
4899	19-35758	Dep.(mn); $5.00(cy), 3(mn) CFSTI
GEMP-	**(Misc.)**	
190b	19-35394	See N64-29785
190i	19-35835	See N64-33781
190L	19-35836	See N64-33782
190m	19-34746	See N64-33783
190n(Pt.A)	19-35834	See N64-33133
338	19-35827	Dep.(mn); $1.00(cy), 1(mn) CFSTI
341	19-35828	Dep.(mn); $1.00(cy), 1(mn) CFSTI
342	19-35829	Dep.(mn); $6.00(cy), 4(mn) CFSTI
344	19-35830	Dep.(mn); $6.00(cy), 5(mn) CFSTI
353	19-35831	Dep.(mn); $1.00(cy), 1(mn) CFSTI
362	19-34678	Dep.(mn); $1.00(cy), 1(mn) CFSTI
HASL-		
161	19-34365	Dep.(mn); $4.00(cy), 5(mn) CFSTI
HMI-B-	**(German)**	
40	19-34617	Dep.(mn)
HW-		
84384	19-35611	Dep.; $4.00(cy), 2(mn) CFSTI
84512RD	19-34679	Dep.(mn); $1.00(cy), 1(mn) CFSTI
HW-SA-		
3484	19-34267	Dep.(mn); $2.00(cy), 1(mn) CFSTI
IA-	**(Non-AEC)**	
808	19-34600	Food Technol., 19: 122-4(1965)
IC-	**(Misc.)**	
65/54	19-35016	Dep.(mn) Phys. Letters, 17: 331-2(1965)
65/58	19-35017	Dep.(mn)
IDO-		
10043(Vol.1) (Rev.1)	19-34400	Dep.(mn); $3.00(cy), 2(mn) CFSTI
17084	19-35847	Dep.; $2.00(cy), 1(mn) CFSTI
17087	19-35379	Dep.(mn); $1.00(cy), 1(mn) CFSTI
IEA-	**(Brazilian)**	
85	19-35760	Dep.(mn)
IFA-CR-	**(Rumanian)**	
50	19-35018	Dep.(mn)
51	19-35380	Dep.(mn)
53	19-34473	Dep.(mn)
IFA-FN-	**(Rumanian)**	
26	19-35582	Dep.(mn)
INR-	**(Polish)**	
584/II/PS	19-34474	CFSTI
604/XIX/D	19-34475	
IPP-	**(Non-AEC)**	
1/32	19-34476	Dep.(mn)
4/18	19-34997	Dep.(mn)
IRD-	**(British)**	
64-59	19-34995	See AD-612901
IS-		
945	19-34188	Phys. Chem. Solids, 26: 1061-5(1965)
1054	19-35491	Phys. Rev., 139: B401-6(1965)
1055	19-34137	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1101	19-35596	Phys. Rev., 139: 1181-8(1965)
1103	19-35597	Phys. Rev., 139: 1333-7(1965)
IS-T-		
13	19-34680	Dep.(mn); $2.00(cy), 1(mn) CFSTI
JINR-	**(Russian)**	
E-2120	19-35019	Dep.(mn)
P-2080	19-35020	Dep.(mn)
P-2091	19-35021	Dep.(mn)
P-2097	19-35381	Dep.(mn)
P-2102	19-35022	Dep.(mn)
P-2103	19-35382	Dep.(mn)
P-2105	19-35184	Dep.(mn)
P-2111	19-35023	Dep.(mn)
P-2117	19-35024	Dep.(mn)
P-2118	19-35185	Dep.(mn)
P-2119	19-34805	Dep.(mn)
P-2121	19-34861	Dep.(mn)
P-2124	19-35025	Dep.(mn)
P-2130	19-35026	Dep.(mn)
P-2137	19-35027	Dep.(mn)
P-2140	19-35028	Dep.(mn)
P-2142	19-35383	Dep.(mn)
P-2143	19-35029	Dep.(mn)
P-2144	19-35186	Dep.(mn)
P-2146	19-34477	Dep.(mn)
P-2151	19-35187	Dep.(mn)
P-2152	19-35188	Dep.(mn)
P-2153	19-35384	Dep.(mn)
P-2159	19-34104	Dep.(mn)
P-2162	19-35030	Dep.(mn)
P-2165	19-34806	Dep.(mn)
P-2166	19-35385	Dep.(mn)
P-2167	19-35386	Dep.(mn)
P-2196	19-35387	Dep.(mn)
JPRS-	**(Non-AEC)**	
30352	19-34897	$1.00(CFSTI)
KAPL-		
3030	19-34320	Dep.(mn); $2.00(cy), 1(mn) CFSTI
KFK-	**(German)**	
307	19-35388	Dep.(mn)
313	19-35389	Dep.(mn)
320	19-35015	See DESY-65/3
LA-		
3194	19-35761	Dep.(mn); $4.00(cy), 2(mn) CFSTI
3219	19-35706	Dep.; $2.00(cy), 1(mn) CFSTI
3281	19-35390	Dep.(mn); $3.00(cy), 1(mn) CFSTI
3305	19-34105	Dep.(mn); $1.00(cy), 1(mn) CFSTI
3316	19-35613	Dep.; $3.00(cy), 1(mn) CFSTI
LA-DC-		
6495	19-35232	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6506	19-33715	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6509	19-35233	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6514	19-34681	Dep.(mn); $2.00(cy), 1(mn) CFSTI
6515	19-34682	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6516	19-35391	Dep.(mn); $2.00(cy), 1(mn) CFSTI
6520	19-35861	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6526	19-34618	Dep.(mn); $4.00(cy), 2(mn) CFSTI
6544	19-34619	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6546	19-35833	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6578	19-34321	Dep.(mn); $2.00(cy), 1(mn) CFSTI
6579	19-35707	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6583	19-35862	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6588	19-35863	Dep.(mn); $1.00(cy), 1(mn) CFSTI
6645	19-34303	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
6913	19-34721	Trans. Met. Soc. AIME, 233: 1252-8(1965)
6974	19-35489	Phys. Rev., 139: B354-61(1965)
7119	19-34176	J. Chem. Phys., 43: 1370-80(1965)
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1124	19-34807	Dep.(mn)
1131	19-35031	Dep.(mn)
1132	19-35392	Dep.(mn)
1137	19-35032	Dep.(mn) Phys. Letters, 17: 70-2(1965)
LMSC-	**(Misc.)**	

Report No.	Abstract No.	Availability
895355	19-35230	See AD-612737
LMSD–	**(Non-AEC)**	
5014	19-34736	See AD-612463
LNF–	**(Italian)**	
64/64	19-34808	Dep.(mn)
64/68	19-34809	Dep.(mn)
65/2	19-34426	Dep.(mn)
65/5	19-34810	
65/6	19-35393	
LR–	**(Misc.)**	
17860	19-34833	See N64-21485
LRP–	**(Swiss)**	
15-65	19-35520	Dep.(mn)
16-65	19-35521	Dep.(mn)
17-65	19-35522	Dep.(mn)
MATT–		
289	19-35523	Dep.(mn); $1.00(cy), 1(mn) CFSTI
MF–	**(Misc.)**	
45	19-35527	See NYO-1480-22
MIT–	**(Misc.)**	
2098-84	19-35080	Nuovo Cimento (10), 38: 291-4(1965)
2098-122	19-35145	Phys. Rev., 139: B151-4(1965)
ML–	**(Misc.)**	
1244	19-34802	See AD-610190
ML-TDR–	**(Non-AEC)**	
64-416	19-34625	See AD-612912
MLM–		
1239	19-34607	Dep.(mn); $3.00(cy), 2(mn) CFSTI
MND–	**(Misc.)**	
3062-8	19-34138	Dep.(mn); $2.00(cy), 1(mn) CFSTI
3169-67	19-34342	Dep.(mn); $2.00(cy), 1(mn) CFSTI
MT–	**(Misc.)**	
51	19-35526	See NRC-7884
MTI–	**(Misc.)**	
65TR-12	19-34294	See NYO-3363-3
N–	**(Misc.)**	
64-18436	19-35524	$1.60(CFSTI)
64-21485	19-34833	
64-21684	19-34834	
64-22453	19-34343	$8.10(CFSTI)
64-22572	19-34835	$1.25(CFSTI)
64-22756	19-33738	$11.50(CFSTI)
64-22765	19-34836	$1.60(CFSTI)
64-22793	19-33739	$3.60(CFSTI)
64-24119	19-34401	$11.00(CFSTI)
64-24239	19-35234	
64-24831	19-34357	$2.00(CFSTI)
64-25566	19-35235	$9.60(CFSTI)
64-26272	19-34683	
64-26578	19-34998	$10.50(CFSTI)
64-27269	19-34684	$4.60(CFSTI)
64-27381	19-34862	$3.60(CFSTI)
64-27740	19-34139	$0.50(CFSTI)
64-27741	19-34140	$0.50(CFSTI)
64-27821	19-34896	$6.60(CFSTI)
64-29785	19-35394	$3.60(CFSTI)
64-30048	19-34863	$1.10(CFSTI)
64-31402	19-34992	See AD-612471
64-33133	19-35834	$3.00(CFSTI)
64-33781	19-35835	$3.00(CFSTI)
64-33782	19-35836	$3.00(CFSTI)
64-33783	19-34746	$3.00(CFSTI)
NAA-SR–		
8884	19-35614	Dep.(mn); $2.00(cy), 1(mn) CFSTI
10006	19-35762	Dep.(mn); $2.00(cy), 1(mn) CFSTI
10612	19-34747	Dep.(mn); $1.00(cy), 1(mn) CFSTI
10743	19-35763	Dep.(mn); $5.00(cy), 3(mn) CFSTI
11142	19-35764	Dep.(mn); $4.00(cy), 2(mn) CFSTI
NAA-SR-Memo–		
10167	19-35765	Dep.(mn); $2.00(cy), 1(mn) CFSTI
10971	19-34322	Dep.(mn); $3.00(cy), 2(mn) CFSTI
10994	19-34323	Dep.(mn); $3.00(cy), 2(mn) CFSTI
11041	19-35766	Dep.(mn); $2.00(cy), 1(mn) CFSTI
11046	19-35767	Dep.(mn); $1.00(cy), 1(mn) CFSTI
NASA-CR–	**(Misc.)**	
84	19-34357	See N64-24831
243	19-34324	$5.00(CFSTI)
52944	19-35835	See N64-33781
52947	19-35836	See N64-33782
52949	19-34746	See N64-33783
52960	19-35394	See N64-29785
52964	19-35834	See N64-33133
53586	19-35524	See N64-18436
54054	19-34343	See N64-22453
54389	19-34339	
55177	19-34836	See N64-22765
55318	19-33738	See N64-22756
56532	19-33739	See N64-22793
56623	19-34401	See N64-24119
56794	19-34896	See N64-27821
56828	19-35235	See N64-25566
56977	19-34998	See N64-26578
57010	19-34862	See N64-27381
58046	19-34684	See N64-27289
NASA-TM–	**(Non-AEC)**	
X-52057	19-34863	See N64-30048
NASA-TN–	**(Misc.)**	
D-2112	19-34835	See N64-22572
D-2430	19-34139	See N64-27740
D-2431	19-34140	See N64-27741
D-2862	19-35525	$2.00(CFSTI)
D-2873	19-34999	$3.00(CFSTI)
D-2874	19-35236	$1.00(CFSTI)
D-2903	19-34864	$1.00(CFSTI)
NBS-MON–	**(Misc.)**	
79	19-35183	See AD-613030
NIRL-R–	**(British)**	
93	19-34685	Dep.(mn); $0.70(BIS); 3s. 6d. (HMSO)
NMI–	**(Misc.)**	
1263	19-34654	Dep.(mn); $3.00(cy), 2(mn) CFSTI
1266	19-34686	Dep.(mn); $4.00(cy), 2(mn) CFSTI
NP–	**(AEC File No. for Non-AEC Reports)**	
14993	19-35395	
15037	19-35615	Dep.(mn)
15043	19-34811	Dep.(mn)
15053	19-34325	
15077	19-35848	Dep.(mn); $10.10(cy), 11(mn) CFSTI
15079	19-34402	Dep.(mn)
15086	19-35000	
15087	19-35864	Dep.(mn)
15088	19-35001	
15090	19-34593	
15095	19-35396	Dep.(mn)
15096	19-34405	
15097	19-34406	
15098	19-35563	
15101	19-34257	Dep.(mn)
15102	19-34258	Dep.(mn)
15104	19-34259	Dep.(mn)
15123	19-34268	
15134	19-34655	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
1232	19-34427	Dep.(mn); $2.60(fs), $0.98(mf) JCL
NRC–	**(Canadian)**	
7884	19-35526	

Report No.	Abstract No.	Availability
8429	19-34222	Can. J. Chem., 43: 1948-51(1965)
NRL–	**(Misc.)**	
6163	19-35517	See AD-610009
6195	19-34141	$2.00(CFSTI)
NRL-Memo–	**(Misc.)**	
1596	19-34748	Dep.(mn); $1.00(cy), 1(mn) CFSTI
NYO–		
98-6	19-34362	Dep.(mn); $1.00(cy), 1(mn) CFSTI
NYO–		
1480-22	19-35527	Dep.(mn); $3.00(cy), 2(mn) CFSTI
2043-108	19-33716	Dep.(mn); $4.00(cy), 2(mn) CFSTI
2391-11	19-35866	Dep.(mn); $2.00(cy), 1(mn) CFSTI
2391-12	19-35583	Dep.(mn); $2.00(cy), 1(mn) CFSTI
2471-2	19-35867	Dep.(mn); $2.00(cy), 1(mn) CFSTI
2744-26	19-33740	Dep.(mn); $1.00(cy), 1(mn) CFSTI
2873-7	19-34142	Dep.(mn); $1.00(cy), 1(mn) CFSTI
3041-1	19-34143	Dep.(mn); $1.00(cy), 1(mn) CFSTI
3274-2	19-34596	Dep.(mn); $2.00(cy), 1(mn) CFSTI
3363-3	19-34294	Dep.(mn); $3.00(cy), 2(mn) CFSTI
3445-3	19-33789	Dep.(mn); $2.00(cy), 1(mn) CFSTI
ORNL–		
3209	19-35768	Dep. mn; CFSTI, $3.00 cy, $0.75 mn
3642	19-35769	Dep.; $3.00(CFSTI)
3658	19-34144	Dep.(mn); $3.00(cy), 1(mn) CFSTI
3751	19-34642	Dep.(mn); $4.00(cy), 2(mn) CFSTI
3793	19-35868	Dep.(mn); $2.00(cy), 1(mn) CFSTI
3810	19-34106	Dep.(mn); $3.00(cy), 1(mn) CFSTI
3812	19-35770	Dep.; $5.00(cy), 3(mn) CFSTI
3821	19-34107	Dep.(mn); $1.00(cy), 1(mn) CFSTI
ORNL-P–	**(Misc.)**	
96	19-33888	Radiation Botany, 5: 223-31(1965)
112	19-34702	J. Am. Ceram. Soc., 48: 297-305(1965)
131	19-34273	Ind. Eng. Chem., Process Design Develop., 4: 333-7(1965)
262	19-33732	Dep.(mn); $3.00(cy), 1(mn) CFSTI
299	19-35564	Dep.(mn); $1.00(cy), 1(mn) CFSTI
485	19-34271	Ind. Eng. Chem., Process Design Develop., 4: 249-54(1965)
621	19-34163	Inorg. Chem., 4: 1080-2(1965)
702	19-34432	Nucl. Instr. Methods, 35: 61-6(1965)
879	19-35449	Nuovo Cimento (10), 38: 316-44(1965)
895	19-34233	Phys. Rev., 139: 1328-32(1965)
915	19-34712	Phys. Chem. Solids, 26: 937-42(1965)
972	19-33852	J. Bacteriol., 90: 223-6(1965)
1076	19-34490	Nucl. Instr. Methods, 35: 34-44(1965)
1107	19-35487	Phys. Rev., 139: B331-9(1965)
1265	19-34407	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1266	19-34687	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1302	19-35397	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1304	19-35398	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1307	19-35399	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1313	19-34408	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1314	19-34524	Nucl. Instr. Methods, 35: 331-3(1965)
1324	19-34409	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1339	19-35869	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1340	19-35870	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1343	19-35400	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1346	19-35401	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1353	19-35402	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1354	19-35403	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1371	19-35404	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1431	19-34656	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1446	19-33958	Dep.(mn); $1.00(cy), 1(mn) CFSTI
ORNL-RSIC–		
8	19-35616	Free(ORNL)
ORNL-TM–		
985	19-34478	Dep.(mn); $1.00(cy), 1(mn) CFSTI
1026	19-35775	Dep.(mn); $3.00(cy), 2(mn) CFSTI
1143	19-35776	Dep.(mn); $2.00(cy), 2(mn) CFSTI
1156	19-35349	Dep.(mn); $4.00(cy), 2(mn) CFSTI
1169	19-35777	Dep.(mn); $2.00(cy), 1(mn) CFSTI
ORNL-tr–		
506	19-34151	Dep.(mn); $1.00(cy), 1(mn) CFSTI; $1.60(fs), $0.80(mf) JCL
610	19-35568	*Dep.(mn); $8.60(fs), $2.93(mf) JCL
660	19-34152	Dep.(mn); $1.10(fs), $0.80(mf) JCL
661	19-34153	Dep.(mn); $1.60(fs), $0.80(mf) JCL
687	19-34750	Dep.(mn); $1.10(fs), $0.80(mf) JCL
ORO–		
627	19-34108	Dep. mn; CFSTI, $3.00 cy, $0.75 mn
PAEC(A)IN–	**(Philippines)**	
646	19-34378	Dep.(mn)
PATENTS	**(British)**	**(3s. 6d. each, U. K. Patent Office)**
988,069	19-34635	
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988,212	19-34307	
988,231	19-34667	
988,283	19-35641	
988,412	19-35642	
988,414	19-35579	
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990,121	19-34637	
990,192	19-34582	
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990,328	19-35644	
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990,428	19-35645	
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995,067	19-35625	
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995,332	19-34313	
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995,523	19-35011	
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1,315,403	19-35659	
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1,330,590	19-35662	
1,331,950	19-35663	
1,331,950(Add.1)	19-35664	
1,331,950(Add.2)	19-35665	
1,331,950(Add.3)	19-35666	
1,332,116	19-35667	
1,333,052	19-35668	
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1,335,149	19-35670	
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1,336,234	19-35671	
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1,347,032	19-35679	
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1,347,154	19-34337	
1,347,937	19-35681	
1,348,573	19-35682	
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1,352,881	19-35685	
1,352,950	19-35686	
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1,353,257	19-35729	
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1,356,074	19-35690	
1,357,382	19-35731	
1,357,745	19-34588	
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1,366,784	19-35694	
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1,187,331	19-35732	
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3,153,622	19-34605	
3,153,722	19-34134	
3,153,725	19-34318	
3,178,257	19-34288	
3,178,354	19-35821	
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3,178,656	19-34463	
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3,180,798	19-35822	
3,180,799	19-35724	
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3,180,803	19-35824	
3,180,804	19-35745	
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3,184,915	19-34356	
3,185,630	19-35825	
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3,185,632	19-35746	
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3,187,182	19-34265	
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PIBMRI–	**(Non-AEC)**	
1243-64	19-35519	See AD-613037
PNE–		
218F	19-34297	Dep.(mn); $2.00(cy), 1(mn) CFSTI
315F	19-34298	Dep.(mn); $1.50(cy), 3(mn) CFSTI
POR–	**(Misc.)**	
1826	19-34299	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
PPAD–		
524-E	19-34774	Dep.(mn); $1.00(cy), 1(mn) CFSTI
2137-532	19-35485	Phys. Rev., 139: B307-14(1965)
R–	**(Misc.)**	
62RPD20	19-35837	
64SD39	19-34683	See N64-26272
2314	19-34641	See EURAEC-1223
2316	19-34676	See EURAEC-1404
RADC-TR–	**(Non-AEC)**	
64-568	19-34769	See AD-612498
RAI–	**(Misc.)**	
347	19-34215	See AD-612536
RFP–		
518	19-34657	Dep.(mn); $1.00(cy), 1(mn) CFSTI
538	19-34260	Dep.(mn); $1.00(cy), 1(mn) CFSTI
564	19-34109	Dep.(mn); $1.00(cy), 1(mn) CFSTI
RISO–	**(Danish)**	
93	19-35565	Dep.(mn)
RL-SA–		
38	19-34110	Dep.(mn); $1.00(cy), 1(mn) CFSTI
RME–		
143	19-34379	Dep.(mn); $2.00(cy), 1(mn) CFSTI
RT-FI–	**(Italian)**	
(64)-16	19-35849	Dep.(mn)
(64)-24	19-34812	Dep.(mn)
(65)-7	19-35566	Dep.(mn)
SAN–		
536-10	19-33719	Dep.(mn); $2.00(cy), 1(mn) CFSTI
SC-DC–		
64-2086	19-35871	Dep.(mn); $4.00(cy), 2(mn) CFSTI
SC-R–		
65-888	19-34295	Dep.(mn); $1.00(cy), 1(mn) CFSTI

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65-903	19-34304	Dep.(mn); $1.00(cy), 1(mn) CFSTI
SC-RR-		
65-129	19-34344	Dep.(mn); $2.00(cy), 1(mn) CFSTI
SCL-DR-		
65-60	19-35872	Dep.(mn); $1.00(cy), 1(mn) CFSTI
SID-	**(Non-AEC)**	
64-1430	19-34360	See AD-608225
SLAC-		
39	19-34813	Dep.; $2.00(cy), 2(mn) CFSTI
SRO-		
116	19-35778	Dep.(mn); $1.00(cy), 1(mn) CFSTI
117	19-35779	Dep.(mn); $1.00(cy), 1(mn) CFSTI
SROO-		
207-30	19-35626	Dep.; $4.00(cy), 6(mn) CFSTI
SU-ML-		
1260	19-35556	Rev. Sci. Instr., 36: 960-8(1965)
SWRI-		
1228-61	19-34688	Dep.(mn); $2.00(cy), 1(mn) CFSTI
1228-62	19-34688	See SWRI-1228-61
1228-63	19-34688	See SWRI-1228-61
1228-64	19-34658	Dep.(mn); $1.00(cy), 1(mn) CFSTI
TID-		
3582	19-35838	Dep. mn; CFSTI, $2.00 cy, $0.50 mn
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7022(Vol.I)(Bk.6)	19-34111	Dep.(mn); $5.50(cy), 5(mn) CFSTI
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